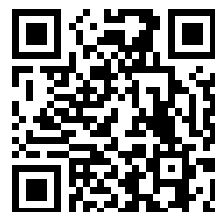


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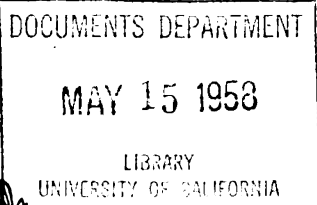
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# Journal

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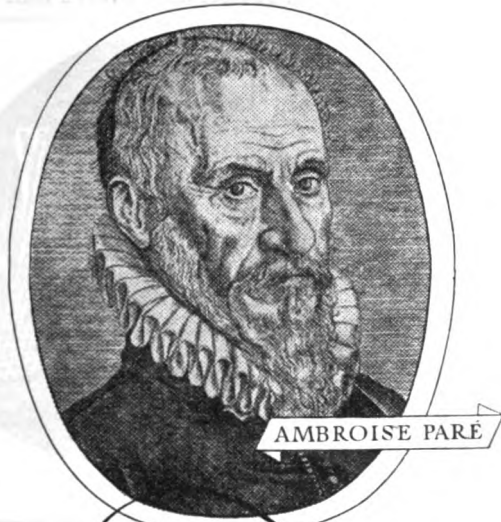
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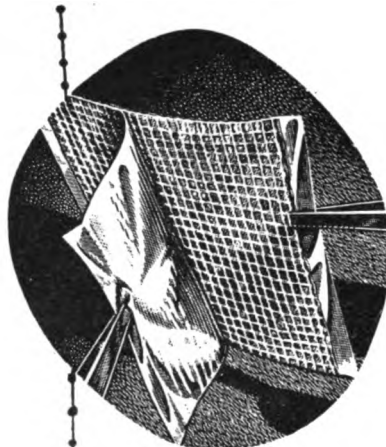
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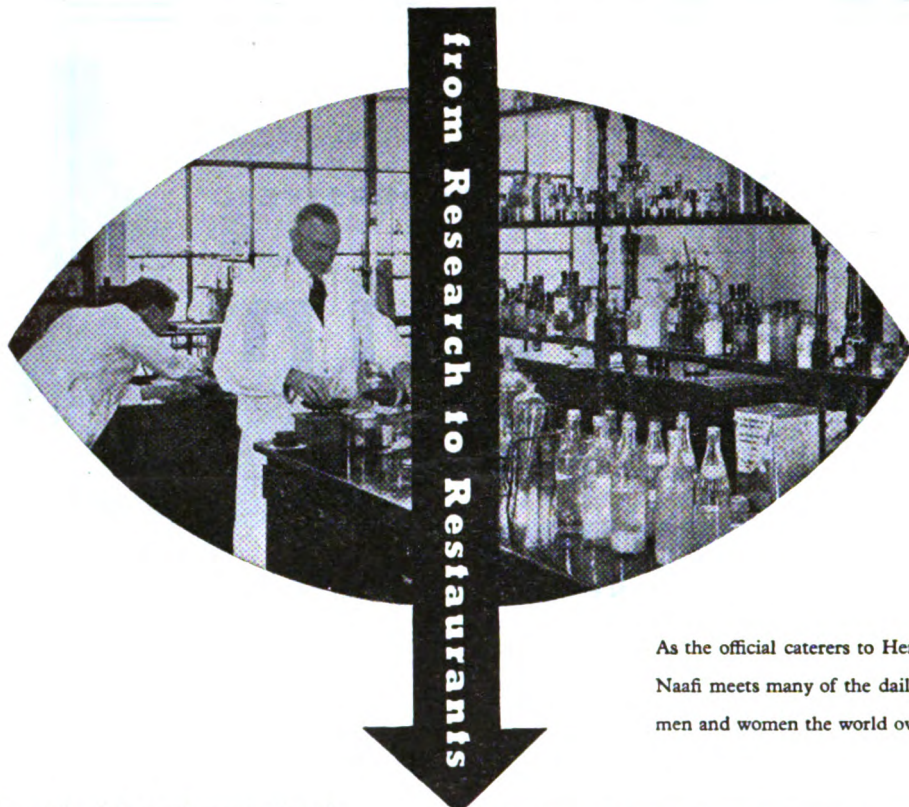
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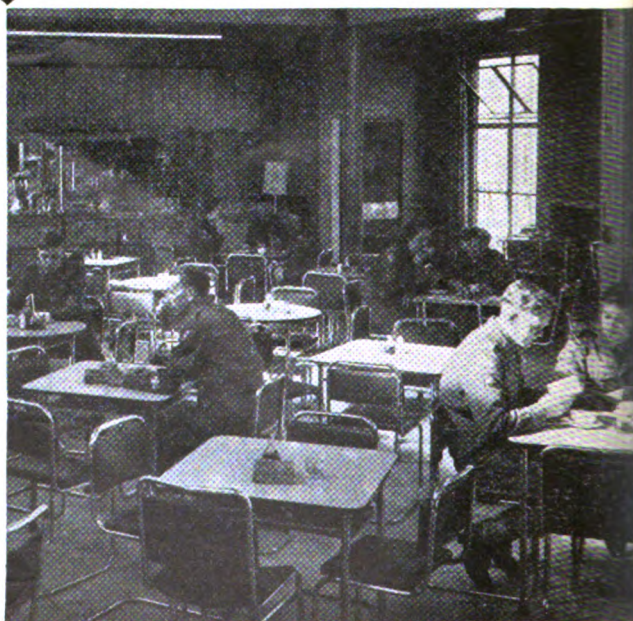
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THE LATE COLONEL J. B. NEAL, T.D., R.A.M.C.

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## THE LATE COLONEL JOHN BARKER NEAL, T.D., R.A.M.C.

*Editor of the "Journal of the Royal Army Medical Corps," 1952-1955*

As briefly announced in our last number, Colonel J. B. Neal died at Tidworth Military Hospital on 2nd October, 1955, at the early age of 43. He was the first serving officer to undertake the editorship of this JOURNAL since the late Sir William Horrocks retired in 1917, and to him is due much of the credit for the revival of the JOURNAL's fortunes after the difficult post-war years. It is indeed a tragedy that he was not spared to continue the work which he had begun so well.

John Barker Neal was born at Whitby, Yorkshire, on 26th February, 1912. He gained an Entrance Scholarship to Dulwich College in 1924 and proceeded to King's College, University of London, in 1930. From there he gained an Entrance Scholarship to the Westminster Hospital in 1932, where he won the Sturges Prize in clinical medicine and the Frederic Bird medal in obstetrics. After qualifying M.R.C.S., L.R.C.P. in 1935, he remained at the Westminster Hospital for the next four years, holding a succession of resident appointments, and for two years was medical officer in the Venereal Diseases department. In 1939 he became Junior Assistant Pathologist to the Seamen's Hospital, Greenwich.

In 1930 he was gazetted a Second-Lieutenant in the 2nd City of London Regiment (The Royal Fusiliers) and transferred to the R.A.M.C. (T.A.) Anti-aircraft Command in 1938. In August, 1939, he was embodied for service with the 1st Anti-aircraft Division and was promoted Acting and then Temporary Major the following year. In 1942 he was posted to the Middle East, where he continued to serve throughout the rest of the war, mainly as a staff officer, passing a Staff College course with distinction at Haifa in 1944. Neal was appointed to a permanent commission in the R.A.M.C. in April, 1945, and shortly after was promoted Lieutenant-Colonel and appointed Officer Commanding 82 General Hospital and A.D.M.S., Cyrenaica District.

Returning home in 1946, he reverted to the rank of Major and resumed the practice of pathology after a brief spell in Germany. He passed the Senior Officers' course in 1949, gaining the Parkes Memorial Medal in Hygiene, and the Specialist course in 1950. He obtained the Diploma in Clinical Pathology of the University of London and was appointed demonstrator in Pathology at the Royal Army Medical College. There he took charge of the Army Tumour Registry and was responsible for the production of the report on the first five years of its work, which was published in 1952. The following year he was awarded the Leishman Memorial Prize and Medal in recognition of this work and was appointed Assistant Director of Pathology, Southern Command, in the rank of Temporary Lieutenant-Colonel. In June, 1953, he assumed command of the David Bruce Laboratories, and was promoted Temporary Colonel in February last year.

Neal was a man of many interests. Professionally, he was essentially a morbid anatomist and histologist. To see him conduct a post-mortem examination was to watch the master craftsman at his task. His opinion as a histologist was widely sought. He also had a profound knowledge of military history and heraldry and was an authority on military uniforms and dress.

With him the JOURNAL was an absorbing interest and the last three volumes remain as a worthy testimony of his editorship, which he assumed in 1952. Scholarly articles from his pen often graced its pages, and our readers will recall the beautiful memorial number to Sir David Bruce on the recent centenary of his birth. The October number contained his last contribution—on the soldier's chest. His other publications included "The Cavalry Surgeon" (this Journal, 97, 45), "Two Reformers in the Army Medical Services" (*Proc. Roy. Soc. Med.*, 46, 601), and "Extracts from Journals of John Francis Smet" (*J. Soc. A. Hist. Res.*, 29, 172).

Neal was one of those naturally unselfish men who always considered the interests of others before his own. He was rarely heard to say an unkind word about anyone. Always impeccably groomed and with old-fashioned princely manners, it was a pleasure to meet him, whether on a social or professional occasion. He remained the same till the end, cheerfully discussing affairs and helping in the correction of proofs within a few days of his death. The JOURNAL and indeed the Corps has suffered a grievous loss.

He leaves a widow and two young boys to whom we extend our deepest sympathy in their bereavement.

Major-General A. Sachs, C.B., C.B.E., Q.H.P., writes :

"The untimely death of John Neal has come as a great shock to his many friends and colleagues. As Director of Pathology, I had an opportunity of following his career when he was both a student and a valued colleague. I always found him most helpful and co-operative—no task was too great.

"He early showed marked aptitude for morbid histology, and after he had taken over the Army Tumour Registry at the R.A.M. College he did much to ensure that the highest standard of work was maintained. Much credit is due

to him for producing the report on the first five years of its work and he was largely responsible for rehabilitating the Pathology Museum.

"Perhaps less well known was his keen interest in the history of military medicine—a subject on which he was rapidly becoming a recognized authority. In lecturing he successfully overcame the serious disability of defective hearing.

"The Corps has indeed lost one of its most promising younger officers, who, had he lived, would undoubtedly have gone far. We all mourn his loss."

Brigadier G. T. L. Archer, M.R.C.P.I., Q.H.S., Director of Pathology, writes :

"The Corps has suffered a great loss in the death of Temporary Colonel J. B. Neal, T.D., R.A.M.C. It would be difficult to overestimate his services to the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS. His carefulness, literary style and patience with contributors made him an ideal editor. As a man, Neal was always courteous and the best of company. As an officer of the Corps which he loved, he had few equals. His professional knowledge and skill, particularly in the field of morbid histology, were outstanding. He was deeply versed in the history of the Corps on which he had contributed papers and delivered addresses. He was closely concerned, both as editor of the Journal and as Corps historian, with the centenary of Army Pathology and with that of Sir David Bruce, both of which occurred in 1955. Such an officer can ill be spared."

A colleague writes :

"It was a privilege to have known John Neal. His wide general knowledge and knowledge of English literature and his deep professional learning made it a pleasure to work with him. His thought for others made him an ideal commander and he commanded the David Bruce Laboratories with outstanding success. He was endowed with a delicious sense of humour which enabled him to see the lighter side of things even at the worst of times, and this coloured his large repertoire of stories of service life which delighted many.

"John loved the Corps and worked for it unceasingly in many ways behind the scenes. The enormous amount of work he did for the R.A.M.C. JOURNAL can only be known to a few and as he preferred to work anonymously he has not received the credit that was his due. He managed to combine the highest standard of professional work as a pathologist with a very real ability as an administrator. This he achieved in spite of his deafness which might well have daunted a lesser man.

"I saw much of him during his last illness. Even towards the end, when all visits must have entailed considerable mental and physical distress, this was never apparent. He invested the sick room with the congenial atmosphere so many had enjoyed in his home, and he maintained an active interest in affairs and preserved his sense of humour until the end.

"John was a man of deep religious faith which was unwavering but never obtrusive. To him too, death was something he 'recognized and did not fear.' "



## *Original Communications*

---

### BLOOD TRANSFUSION IN THE STATION HOSPITAL

BY

Captain M. H. KING, M.B., M.R.C.P.

*Royal Army Medical Corps*

*Formerly pathologist to the B.S.H., El Ballah, M.E.L.F.*

#### INTRODUCTION

To every Station Hospital there will in due course be brought the very gravely injured, some of whom will need a massive and urgent transfusion. The supply of that transfusion is the subject of this article. If these occasions are rare, the keeping of a blood bank will not be practical, and, if the hospital is abroad, there will not be the National Blood Transfusion Service to call upon. Under these conditions the supply of up to a score of bottles of blood is an urgent, anxious, and very rewarding task.

Some of the lessons learnt in providing such transfusions are recorded here in the hope that they will be of use to others. The article is based on experience gained at the Station Hospital, El Ballah, M.E.L.F., in the troubles of 1953 and 1954. It does not deal with the problems of frank warfare, but with the uneasy state which is neither war nor peace but a wearisome succession of incidents. Because such incidents usually involve only small numbers of casualties, the full resources of the hospital transfusion service may often be turned to a single case. Transfusions may then be given of a size impossible where many casualties require to be transfused at once. In time of peace, accidents may be the cause of a similar need for blood, and, except for its rarity, the problem will be identical.

In the present unsettled condition of the world, medical officers in Station Hospitals abroad may frequently find themselves called upon to treat those injured in incidents. These may often be gunshot wounds in relatively small numbers. The problem is thus an important one, and, if the standard of medical care is to be high in Station Hospitals, the standard of their transfusion service must also be high.

#### THE DONOR PANEL

The foundation of an effective transfusion service is its donor panel. This is particularly important when there is no stored blood to rely upon, every pint being taken from a donor only when it is required. It has been found useful to keep two panels. The first is a panel inside the hospital made up of as large a fraction as possible of its staff. It is used to provide the first pint or two of an urgent transfusion and as a source of cells of known group. The second panel

is drawn from units outside the hospital and is used to provide the later pints of an urgent transfusion as well as for all transfusions where time permits.

The panel inside the hospital is easily recruited by a personal approach to each member of the staff, and, if the officer commanding will become a blood donor himself, so much the better. Forty or fifty donors inside the hospital form an adequate panel.

The panel outside the hospital is less easy to recruit. It is best made up of fifty to a hundred donors in each of a number of large static units close by. The temptation to rely upon a small number of donors in many scattered units is best avoided for they are of little use in an emergency.

It is not easy to recruit a large panel in a unit and the best way to start is a personal approach to the commanding officer. An appeal can be put on the unit notice board asking donors to come forward, or the transfusion officer can address a parade. Few donors will answer an appeal on the notice board, and, if he addresses a parade, the response depends on his powers of persuasion. The best method by far has been found to be to ask all those not wishing to be donors to say so and to parade the remainder.

This should be done at the unit's convenience, and is easily combined with the routine inoculations. If all is organized well, it is possible to take samples for blood grouping at the rate of just under a man a minute. Working with the unit medical officer, samples can easily be taken from a hundred men in the course of an afternoon.

Records of the donors on the panel are best kept in a card index. A copy of one of the cards actually used is illustrated (Fig. 1).

Laboratory reference number		GROUP
Name & Number..... Rank..... initials.....		Rhesus
Unit..... Date grouped.....		Kahn
Date of demobilisation.....		Signed
Date of donation	Blood serial number	To whom given

FIG. 1. Index card used for recording blood donors

Samples of blood for grouping are best taken into "bijou" bottles, but, if these are not available in the required numbers, empty penicillin bottles can be used, if previously plugged with cotton-wool and sterilized. Syringes for venipuncture are seldom available in the required numbers, but a large intramuscular needle attached to an inch of rubber tubing is a very effective substitute. These devices can either be sterilized individually in test tubes or else packed, layer upon layer, in a tin. They are very convenient and safe if each layer is packed between gauze and care taken not to touch the points of the needles. They are, however, not as easy to use as a syringe for venipuncture and some syringes must always be to hand in case veins are difficult.

On the parade the transfusion officer will need three assistants: two sit at a table, where one records the particulars of the donor on an index card, while the other records them on the label of a "bijou" bottle. Both the bottle and the card are then handed to the donor, who is asked to check them as he moves in a queue towards the transfusion officer. The transfusion officer himself checks these while his third assistant prepares the donor's forearm for venipuncture.

During this operation it is important to glance away occasionally from the donor's forearm to his face, for those about to faint give warning by their pallor. An occasional donor will always faint. To minimize the possible evil consequences of this it is important to choose a room with a carpeted or linoleum-covered floor. It is also desirable that as few as possible see their fellows being venipunctured.

Some of the men will have been donors at their depots and will possess blue National Blood Transfusion Service booklets. These can be collected, copied on to filing cards and returned to their owners. These donors form a convenient and reliable part of the panel, but great care must be taken to see that their booklets are copied correctly. The transfusion officer is well advised to check these himself to avoid clerical errors and their possibly serious consequences.

When taking samples from donors at a unit, arrangements should be made for calling them up when the need arises. The Medical Centre should keep a list of the unit donors; the larger this is the easier it will be to find donors in time of need and the less trouble will be caused to the unit. A telephone message straight to the Medical Centre is the best way of calling them, and great care must be taken to define the degree of urgency.

The donor panel is never static, for the members of a unit are always changing. Unless added to, the panel will inevitably diminish. The best way of doing this is to give each draft, as they arrive, the opportunity of becoming donors.

#### THE BLOOD BANK\* AND ITS EQUIPMENT

Almost more important than the donor panel is the siting and equipment of the Blood Bank itself. The close proximity of the Blood Bank to the Operating

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\* The word "Bank" is used here in a restricted sense to mean the room where blood is taken and crossmatched. It is not a true blood "Bank" as that is usually understood.

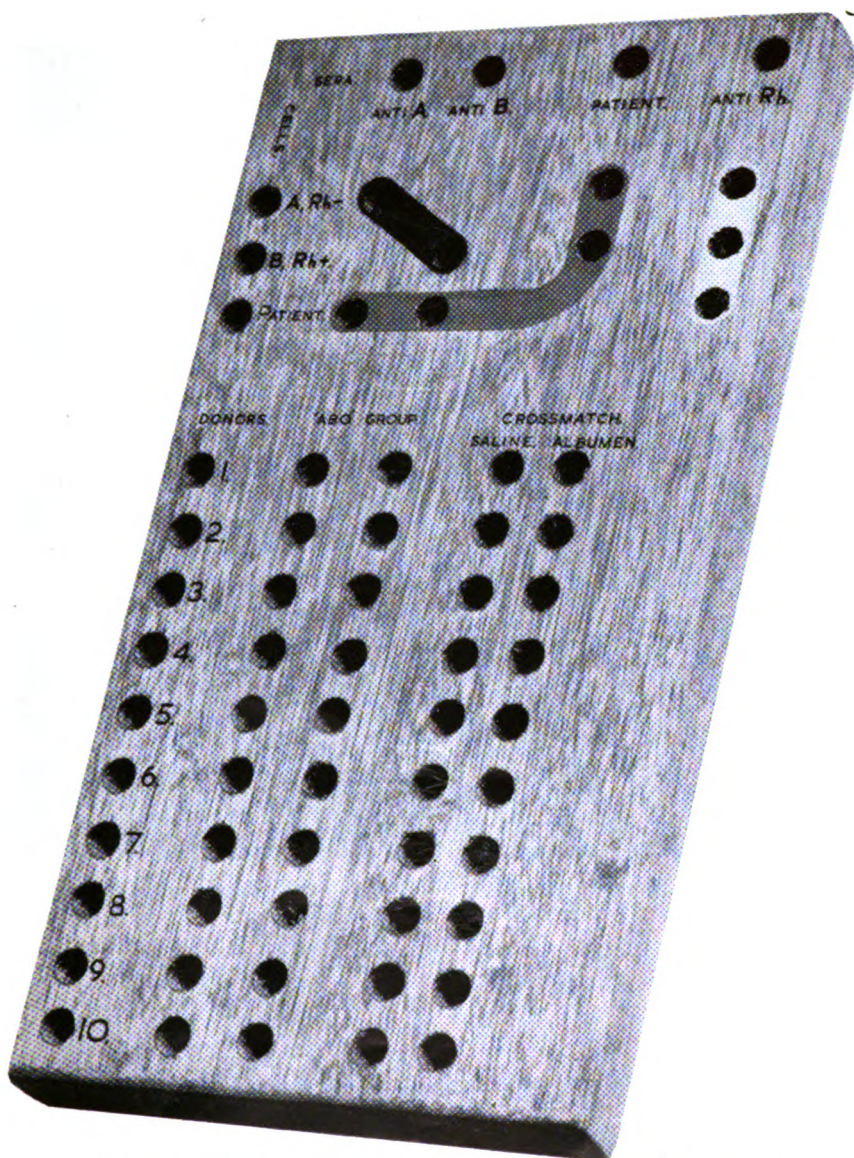
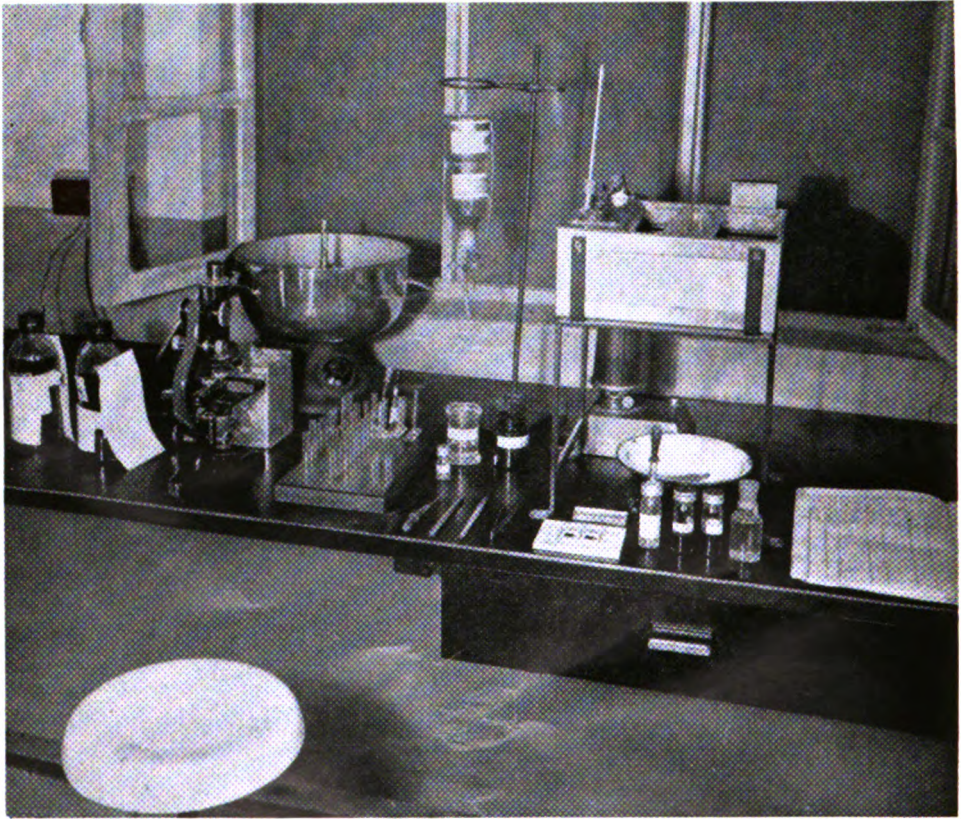


PLATE I. The Board used for Blood Grouping and Crossmatching.

Cell suspensions are placed in the tubes down the left-hand side of the board and sera in a row along the top; cells are transferred to the tubes of the same horizontal row and sera to the tubes of the same vertical row. Painted figures on the board distinguish the tubes used to determine the patient's "ABO" and Rhesus group as well as those used to test the antisera.





**PLATE II.** The bench of the Blood Bank at a Station Hospital during an urgent transfusion.  
(For list of equipment see Appendix II)

Theatre is essential if proper liaison is to be possible between the transfusion officer and the anæsthetist, and indeed, the closer they are the better. If no other room is available it is possible to combine the Blood Bank and the Plaster Theatre. In this connection it is important to note that the transfusion officer and the anæsthetist cannot be combined in the same person, for, under conditions of stress, they may both be fully occupied at the same time, one anæsthetizing the patient and the other providing blood for him.

The Blood Bank must be large enough to contain two beds and a bench for the apparatus for blood grouping and crossmatching. Running water, a refrigerator, and a telephone are almost essential, and a cupboard to contain transfusion bottles and sets is very useful. Close by, there should be a room with arm-chairs, magazines, and arrangements for brewing tea. Here donors may wait and recuperate after being bled.

It may appear more convenient to do the grouping and crossmatching in the hospital laboratory or clinical side room. It has, however, been found less trouble in the end if a centrifuge, a microscope, and a water bath are provided in the Blood Bank where the technician can be supervised personally.

The only piece of specialized equipment needed by the Blood Bank is a board for holding numbers of small test tubes. The board illustrated (see Plate I) was evolved for this purpose and works well. There is need of a standard apparatus of this type, for it minimizes the chance of errors that are so easy under stress, permits the technician to be readily watched, and makes a change of operator easier, should this prove necessary. The cell suspensions are placed in a row down the left-hand side of the board and sera in a row along the top. The cells are transferred to every tube in the same horizontal row and the sera to every tube in the same vertical row.

Painted figures on the board distinguish the tubes used for testing the grouping sera from those used for the patient's "ABO" and Rhesus group. The tubes used in regrouping and crossmatching the donors are more obvious and require no special distinction.

Many minor articles of equipment are needed which must be readily available, for valuable time may be wasted in finding them. They are listed in Appendix II and illustrated in Plate II.

### SUPPLYING BLOOD WHEN THE DEMAND IS URGENT

Procedure varies with the urgency of the call for blood, and for convenience it is proposed to consider here only cases of great urgency. The best way of appreciating the degree of haste required is for the transfusion officer to see the case himself.

Medical officers in the area should be asked to give prior warning, if they can, when sending in cases requiring transfusion. Valuable use can be made of the minutes thus gained in making sure that the equipment is ready, and in obtaining samples of "A" Rhesus negative and "B" Rhesus positive cells from members of the hospital staff. This is conveniently done from a prick in the finger straight

into a test tube of saline. The antisera can be reconstituted and one of the unit donor panels warned of an impending call for blood donors.

Thus prepared, the arrival of the patient can be awaited with confidence. In Reception 10 ml. of the patient's blood are taken into a centrifuge tube and at the Blood Bank a few drops of this are transferred to a tube of saline. This is then centrifuged, the supernatant removed, and the cell concentration adjusted to about 5 per cent. This washed cell suspension is then used for a preliminary "ABO" group on a slide, and, at the same time, a confirmatory "ABO" group and a Rhesus group are set up in the tubes of the board. As soon as the patient's blood has clotted it is centrifuged, and, when enough serum has separated, this is used to confirm the patient's "ABO" group further by being set up against "A" and "B" cells. Thus at an early stage the patient's blood group will have been determined by the slide method and confirmatory tests set up. Rhesus negative donors of the correct "ABO" group are then sent for from the inside and the outside panels. Donors from the hospital are immediately available and can be bled at once. Valuable time is saved if, while the transfusion officer prepares to do this, the technician takes a sample of blood from the donor's finger for grouping and crossmatching.

Shortly after the first pint has been withdrawn, a point will have been reached when the tube group will have been standing on the bench for twenty minutes, and the tubes for the crossmatch will have been in the water bath for a quarter of an hour. If the blood is wanted urgently, these tests can be read and if satisfactory it can be given. Second and subsequent pints of blood should be capable of following on very rapidly and supply should soon catch up with demand. If the donors are regrouped and crossmatched from a prick in the finger, the later pints for the transfusion will have been adequately tested before being given.

When the Rhesus group has been set up for twenty minutes it can be read, and if it is unequivocally positive the patient can then be given Rhesus positive blood. If it is negative it can be read again later, and for this to be possible it is important that it should be set up in sufficient volume.

The fascination of such work lies in the desperate importance of the issue, the extreme ease of a slip, and the nice judgment required in assessing the relative merits of giving inadequately tested blood on the one hand and withholding it on the other.

#### TESTING THE ANTISERA AND THE TECHNIQUE OF THE "ABO" GROUP

Testing both the serum and the cells is standard "ABO" grouping practice for routine purposes. It is, however, usual in emergency work to rely upon testing the cells alone and the extra work involved in doing both cells and sera must be justified. Suspensions of "A" Rhesus negative and "B" Rhesus positive cells can be used three times. Firstly, as controls in the Rhesus group where they are essential; secondly, to test the potency of the anti "A" and anti "B" sera; and finally with the patient's serum to confirm his "ABO" group.

The anti "A" and anti "B" sera issued have never been found to give false positive reactions in our hands, and, provided the cell suspensions are washed, are unlikely to do so. Danger lies in the possibility of false negative reactions due to low titre sera. While "in date" they are stated to be effective to a titre of not less than 1/64. This has been found to be true for all tubes tested before their expiry date, but owing to the exigencies of the service low titre sera may have to be used. To counter this, and the theoretical failure of a serum while still "in date," it has been our practice to test every tube of serum used. False negatives in the grouping of the recipient are fortunately less serious than false positives, but they are undesirable in that the donor's antibodies may cause the destruction of the recipient's cells, particularly when large volumes are transfused. A further advantage of routinely testing the antisera is the rapidity with which an incorrect "ABO" group, due to weak sera, can be suspected. With sera of standard titre agglutination is rapid in the tubes of the test. If this is not so the serum is probably of low titre.

Having established the potency of the antisera it should only then be necessary to test the patient's cells. To test his serum as well, though not essential, does, however, add a simple cross check that takes very little time.

It is worth recording that on one occasion, when the reading of the control tests just described was delayed, a patient was temporarily mistransfused as "O" instead of "A." On another occasion a patient was similarly mistransfused at another hospital where these controls had not been used.

Occasional anomalous reactions due to the " $\alpha_1$ " antibody may complicate the grouping of the patient's serum. If test "A" cells are chosen at random they will in theory complicate approximately 0.3 per cent. of all "ABO" blood groups, but, provided that it is realized that this may happen, no trouble need ensue (Whitby and Britton, 1953). Ideally "A<sub>2</sub>" cells should be used, but to find them would be a complication that would outweigh their benefit.

### RETESTING THE "ABO" GROUP OF EACH DONOR

The first few pints of an urgent transfusion may well have to be given without the correct time having elapsed for crossmatching. Under these circumstances an "ABO" mismatch is more likely to be picked up with the high titre antisera supplied than it is with the patient's serum where these isoantibodies are usually in lower titre. Under conditions of real urgency, regrouping of the donor is the test to be relied upon. Significant antibodies other than those of the "ABO" system appear to be rare enough in a population of young adult males to be disregarded under these conditions.

### CROSSMATCHING IN ALBUMEN AND SALINE

An albumen and a saline crossmatch may seem an unwarranted complication where time is short and have in our practice sometimes been omitted. If blood for crossmatching is taken from the donor's finger before he is actually bled, and if the tests are read only when the blood is actually wanted, at least ten minutes



for crossmatching is always possible. If the tubes are centrifuged for a minute at a thousand revolutions a minute before being read, even this length of time is well worth while. There is usually ample time to crossmatch the later pints for a transfusion in albumen and in saline. This is standard practice because each type of crossmatch is to some extent specific for the type of antibody most easily elicited.

### THE RHESUS FACTOR

The giving of Rhesus incompatible blood to women of child-bearing age, or to those likely to want subsequent transfusions, is seldom defensible and Rhesus negative blood should always be found for them. The problem that concerns the Station Hospital is the remaining majority of cases. If the transfusion can wait the standard two hours required for Rhesus grouping, all is simple. So often, however, the need is more urgent and the problem is then whether to waive the Rhesus group altogether, or to give Rhesus negative blood until the Rhesus group is known.

Five or more pints of blood may be required during this time, and, as these occasions may be frequent, a large Rhesus negative panel must be maintained. If this ideal policy is to be followed the total donor panel will have to be larger than it otherwise need be, with a corresponding increase in the work of the transfusion officer and the blood grouping laboratory. Should the work of the hospital merit the keeping of stored blood for emergency use, the problem will be even more acute, for some Rhesus negative blood will inevitably be discarded each time the bank is renewed. The earlier the Rhesus group is known the less the Rhesus negative blood used, and for this purpose a rapid Rhesus test is important. With the sera issued the standard time for the test is two hours. If, however, the test is set up in albumen initially, it can be read in a shorter time and Rhesus positive blood may be given as soon as a positive result is obtained. If the time for the Rhesus grouping is shortened the tubes should be gently centrifuged in the way described for the crossmatch.

It is a point of interest how much extra trouble is justified in avoiding the Rhesus sensitization of males which takes place only in some of those at risk. The evil effects of this can always be circumvented in good hands should they require subsequent transfusion.

It is the policy in this hospital to ignore the Rhesus group during the urgent transfusion of males, and the procedure described above is, therefore, theoretical rather than practical.

The technical complications of the Rhesus group are minimized using the board described above.

### UNIVERSAL DONOR BLOOD

The use of universal donor blood under emergency conditions appears to have much to commend it. It is, however, open to two theoretical objections. The first and potentially the more serious is the possibility that, if the donor's blood

is not adequately regrouped and crossmatched at the time, blood of another group may be given in error. The second is the effect that the donor's iso-antibodies may have on the recipient's cells. The exact significance of this is difficult to ascertain, but Mollison (1951) quotes Ebert and Emerson as noting 1 per cent. of frank hæmolytic reactions in "A," "B," or "AB" patients receiving routine transfusions of group "O" blood. They also considered that some asymptomatic destruction of the recipient's cells was invariable after multiple transfusions of group "O" blood. Gardner and Tovey (1954) quote several authors as observing hæmolytic reactions under these conditions and it must be concluded that the danger exists.

For this reason it has been our practice only to give homologous blood. With a little organization the "ABO" group can be determined very rapidly by the slide method, and, if a tube group is set up at the same time, it can be confirmed before blood is given. Should, however, there be a delay in determining the patient's blood group, universal donor blood can be given and it undoubtedly has a place in Station Hospital transfusion practice.

### DEXTRAN

Dextran has been widely used in preference to plasma because, until recently, the plasma supplied in M.E.L.F. was prepared in 1946, and was viewed with disfavour by the surgical staff who attributed reactions to it. No reactions have been observed with dextran which has proved invaluable in restoring the blood volume while blood was being obtained. One of the disadvantages of dextran is its power of inducing heavy rouleaux formation and thus complicating the task of grouping and crossmatching. Provided that at least 10 ml. of blood are withdrawn before any dextran is given the problem will not arise, but the transfusion officer must be able to face it when it does. Minor rouleaux formation can be dispersed by dilution with an equal quantity of saline. The use of 7 per cent. sodium salicylate as a suspending medium has proved effective and, where time permits, the Sheffield technique employing 20 per cent. albumen is said to be of value. Provided that the patient's cells are well washed they can always be grouped no matter how much dextran is present.

### STORING BLOOD

Blood is usually needed too seldom in a Station Hospital to be worth storing. The occasion for doing this may, however, arise, and it is sometimes useful to store blood a few days for a particular patient. Storage facilities must therefore be available.

The optimum temperature for storing blood is 4° C. This can be satisfactorily maintained in a domestic refrigerator and recorded with a maximum and minimum thermometer. While blood is being stored the transfusion officer should visit the refrigerator daily and record the temperature at which he finds it as well as the maximum and minimum. These figures are conveniently plotted graphically, when it will be found that the only temperature to vary

greatly is the maximum, which will depend upon how much the refrigerator is opened. The setting of the thermostat required to maintain the temperature at 4° C. has been found to vary with the external temperature and to require altering as the weather changes. The post-transfusion survival time of blood is

Front view of label					Back view of label				
<b>ARMY BLOOD TRANSFUSION SERVICE</b>					<b>FOR THE TRANSFUSION OFFICER'S USE</b>				
I certify that this blood has been cross-matched and is compatible for :—					Serial No. of blood or plasma.    Blood group				
							<div style="display: flex; justify-content: space-between; padding: 2px;"> <span>ABO</span> <span>Rh</span> </div>		
The donor's particulars :—									
Service No.		Rank		Name and initials		ABO		Rh	
Service No.		Rank		Name and initials		ABO		Rh	
<div style="display: flex; justify-content: space-between;"> <span>..... Date.....</span> </div> <div style="display: flex; justify-content: center;"> <span>(Signed)</span> </div>					<div style="display: flex; justify-content: space-between;"> <span>..... Date.....</span> </div> <div style="display: flex; justify-content: center;"> <span>(Signed)</span> </div>				
<b>INSTRUCTIONS TO NURSING STAFF</b>					<b>FOR THE MEDICAL OFFICER'S USE</b>				
<p><b>MAKE ABSOLUTELY CERTAIN</b> that the number, rank and name above correspond exactly with that of the patient and ask somebody to check this.</p> <p>When this bottle is empty replace the cap and ask the medical officer to fill in the details on the back of this label. When this is done return the <b>UNWASHED</b> bottle to the blood bank with its label still attached.</p> <p><b>NEVER</b> tear this label from the bottle.</p> <p>A full bottle of blood should not be put in a ward refrigerator; an empty bottle is best kept there until it can be returned to the bank.</p> <p>Do not send for blood until it is needed.</p> <p>Blood is not to be warmed before use except under the direct supervision of a medical officer.</p>					<p>Signed..... Date.....</p> <p>Hospital.....</p> <p>This blood was given <span style="margin-left: 20px;">without incident</span>  <span style="margin-left: 100px;">with reactions</span> (Signed)</p> <p>Details of the patient's clinical condition :—</p> <p>If reactions ensue full clinical details are to be given to the transfusion officer. He will want a complete temperature chart with the times of all transfusions and other clinical events inserted.</p> <p>Exact symptomatology must be recorded with particular reference to pains in the head, chest, or loin, rashes, rigors, oliguria, anuria, or jaundice.</p>				

FIG. 2. The "tie-on" label for blood bottles.

diminished if it is not stored at 4° C., and there should be no hesitation in discarding it if the storage temperature should alter significantly. It is easy to store blood in a domestic refrigerator if it is visited often and adjusted carefully.

When blood is stored the opportunity should be taken of testing its "ABO" and Rhesus group. This is standard practice and is a valuable safeguard, for no panel should be reckoned as being absolutely reliable.

## RECORDS AND THE AVOIDANCE OF CLERICAL ERROR

These two problems are closely bound up with one another. In published accounts of mismatched transfusions "Clerical Error" ranks high as a cause; it is worth making a great effort to reduce it to a minimum. The system of checking already described should minimize the chance of error when samples are taken initially from volunteer donors. No "F. Med. 12" is needed if the filing cards accompany the specimens to the laboratory and a further source of error is avoided. These cards are returned for filing together with booklets for issue to the donors. When a donor is bled, this booklet or his filing card must be checked and his particulars recorded.

Under stress the record system needs temporary pruning. All that is then required is a simple serial number which is recorded on the bottle of blood, on the tubes for crossmatching, and against the donor's name in the record book. If the blood for testing is taken from the donor's finger before he is bled, this same serial can be recorded on his forearm in grease pencil and checked later by the transfusion officer as he withdraws the blood.

Records are simple when patients are transfused one at a time by one person. Under other circumstances records and labels become more important and deserve some attention. The "tie-on" label illustrated (see Fig. 2) is a modification of that at present used and contains some much-needed instruction to the staff on the wards who may have had little experience of blood transfusion. Coloured "stick-on" labels denoting the group of the blood have also been used and are invaluable. An excessive importance may appear to have been given to stationery; it is, however, believed to make an important contribution to the running of an efficient and reliable transfusion service.

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## APPENDIX I

This is a brief record of the cases transfused at the Station Hospital, El Ballah, during the last three months of 1953 and the first three months of 1954. They form a record of the variety of cases with which a station hospital may have to deal, and the quantity

of blood that may be required. During most of this time the organization of the Blood Bank was not up to the standard of that just described.

<i>Name</i>	<i>Injury</i>	<i>Quantity of Blood given Pints</i>	<i>Result</i>
(1) Dvr. B.	Road accident. Severe rotation injury to the thigh.	5	Survived.
(2) Civ. M. H.	Aged 6. Road accident. Head injuries.	1	Died.
(3) Pte. B.	Sprue. Megaloblastic anæmia. Melæna.	3	Survived.
(4) Spr. J.	Chronic diarrhœa due to Crohn's disease. Torrential melæna treated by emergency hemicolectomy.	12	Survived.
(5) Pte. D.	Multiple scalp wounds.	2	Survived.
(6) Pte. G.	Accidental G.S.W. of the abdomen. Given nine pints of blood at laparotomy and three some days later. Died after a second laparotomy for a secondary hæmorrhage for which he was given twenty-one pints of blood.	33	Died.
(7) Gnr. W.	Mortar bomb accident. Injured face and hands.	1	Survived.
(8) Pte. C.	Accidental G.S.W. of the abdomen.	11	Died.
(9) Civ. C.	Melæna from peptic ulceration.	5	Survived.
(10) Sgt. A.	Peritonitis from appendicitis.	2	Died.
(11) Civ. K.	Peptic ulceration.	2	{ Blood supplied to an outside hospital. Both survived.
(12) Civ. M.	Bleeding œsophageal varices.	2	
(13) Pte. A.	Abdominal G.S.W.	6	Died.
(14) Pte. S.	Myeloid Leukæmia.	3	Died.
(15) Gdsm. D.	G.S.W. abdomen with cauda equina injury.	6	Survived.
(16) Major B.	G.S.W. abdomen.	10	Died.
(17) Civ. M.	G.S.W. thigh.	5	Died.

## APPENDIX II

### THE EQUIPMENT NEEDED FOR BLOOD GROUPING AND CROSSMATCHING

(This lists the equipment shown in Plate II)

Two bottles of blood being crossmatched.

A microscope, lamp, and centrifuge.

The board set out with antisera and tubes for crossmatching.

A dispenser for filling tubes with saline.

20 per cent. albumen and jars for saline and waste.

Pipette, grease pencil, diamond, and forceps.

Water bath and bowl for dirty tubes.

Slides and a porcelain tile with depressions.

A universal container with a Pasteur pipette graduated at 1 ml. This contains distilled water and is used for reconstituting the antisera.

Universal containers containing stock suspensions of "A" Rhesus negative and "B" Rhesus positive cells. These are kept aseptically in acid citrate dextrose and last at least a month.

A needle for withdrawing samples from the finger.

The record book.

This layout of the apparatus permits all the operations of grouping and cross-matching to be done without the operator leaving his seat.

## THE IMPORTANCE OF CHANCROID IN AFRICA

BY

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THE true incidence of chancroid throughout Africa is unknown, although it is apparent that it is the venereal disease next in importance to syphilis and gonorrhœa, in some places being more prevalent than primary syphilis.

Although chancroid is not capable of arresting the development of whole populations, as are gonorrhœa and syphilis by causing sterility and abortion, and although it has no comparable serious sequelæ to those of these two diseases, it is a painful and sometimes locally mutilating complaint. Bubo formation is common, with the subsequent interference with the activities of the patient, and a few may lose parts of their genitalia from phagedenic ulceration. In many parts of Africa, too, patients seeking advice for genital sores are admitted to hospital until the sores have healed. As frequently all genital sores are assumed on clinical grounds alone to be syphilitic, and neoarsphenamine has not yet been universally replaced by penicillin (although the former drug is largely ineffective in soft sore), many working weeks are lost from these reasons.

More serious, however, is that chancroid is an important yardstick by which the efficacy of Western Medicine is judged by the African, and an inadequate treatment for chancroid will result in persons seeking the advice of unqualified herbalists when they have the chancre of syphilis. Also, with the growing activities against the venereal diseases in Africa, a realization of the true part played by chancroid in the causation of genital ulcers is essential for a proper appreciation of the results obtained in the treatment of venereal syphilis, such "syphilis" in the African being a mixture of chancroid and chancre. It is considered, therefore, that a closer investigation of the problem of chancroid in Africa is desirable.

### INCIDENCE OF CHANCROID IN AFRICA

A number of African territories do not report chancroid, but this does not mean that the condition is rare. The diagnosis of venereal diseases is often in the hands of semi-skilled African orderlies and all genital sores, including chancroid, tend to be labelled "syphilis," while a few cases are doubtless classified under "other venereal diseases." Moreover, the hospitals and dispensaries usually listed in the annual returns are governmental ones and no figures are available for many of the large number of mission institutions. Most hospitals

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lack a dark-field microscope and for this reason it may be considered expedient to regard such cases as syphilis. Also vast tracts of Africa still have no hospitals at all at which sufferers may attend (although the incidence of chancroid is likely to be low in these areas), and everywhere, even in the towns, much treatment is still in the hands of unqualified persons.

Any figures obtained from official sources, therefore, have to be viewed with these very considerable reservations in mind and their value is limited in assessing the true magnitude of the problem of chancroid in Africa. It is evident, however, that chancroid at once becomes officially more prevalent when returns are available from a venereal diseases clinic staffed by persons who are capable on account of equipment and experience of recognizing the condition. It must not be forgotten, however, that chancroid, like all venereal diseases, is more common in urban areas and such clinics are more likely to be sited in places where venereal diseases are especially rife.

Those who have experience of venereal diseases consider that chancroid is commoner in Africa than is generally known. Dr. G. C. Cochrane (2) writes that this is especially true in Kenya. During the war, in the 2,000-bedded Military V.D. Hospital at Thika, drawing troops from Nairobi and other large centres, at least 20 per cent. of the patients had chancroid. In the East African Command generally the relative incidence of the venereal diseases was syphilis 1, gonorrhœa 3.5 and other venereal diseases 3—of which the vast majority was chancroid. In Uganda, during the period 1929-1939, chancroid accounted for 23 per cent. of all venereal diseases patients in the European and Asian hospitals, Kampala, and 13 per cent. of all venereal diseases patients at the African hospital, Mulago. The apparent lower incidence at the African hospital was due to the large number of chronic gonorrhœa cases admitted in those days. Similar experience has been reported from the Gold Coast (16) (17) and Southern Rhodesia (18) (24) (27).

The last war, with the organization of the African into the military machine, did much to spread the disease. The medical officer at Tamale, in the Northern Territories of the Gold Coast, for example, told me that of 29 cases of chancroid no less than 20 were noted in soldiers recently returned from leave, and 2 in others recently posted to the unit.

However, apart from towns or military concentrations, the disease is generally uncommon. Dr. Evans (3), of the V.D. campaign at Fort Jameson, Northern Rhodesia, states that under favourable diagnostic conditions, in 1951 only 7 cases of chancroid were noted in the Eastern Province compared with 2,393 cases of syphilis—the incidence of syphilis being 8 per cent. in 18,000 Africans examined in this area. Similar findings were noted in the Barotse Province. In Lusaka, the capital, on the other hand, 3 cases were noted in 604 consecutive out-patients attending the African hospital.

Early in 1953 letters were sent to the Health Departments of the territories of Africa requesting information concerning the incidence of chancroid. The replies received, together with the author's own experience, are summarized in the following tables.

Table 1. *Chancroid: African cases reported in a number of territories*

Territory	Source of figures	Year	Syphilis	Gonorrhœa	Chancroid
Basutoland	Government hospitals and dispensaries	1950/51	11,683	3,773	51
Bechuanaland	ditto	1950	9,179	2,554	290
Belgian Congo	ditto	1948/51	58,687	223,475	1,417
French Cameroons	ditto	1939/52	699,073	688,200	25,422
French Dahomey	ditto	1950/51	24,600	10,082	1,221
French Somaliland	ditto	1951/2	1,351	2,211	253
Gold Coast	V.D. Clinic, Military Hospital, Accra	1943/4	238	2,414	789
Northern Rhodesia	In-patients, African hospitals	1947/50	12,168	4,635	165
Kenya	V.D. Clinic, Infectious Diseases Hospital, Nairobi	1949/51	6,749	8,801	679
Mozambique, Portuguese East Africa	Government hospitals (15 districts)	1950/52	—	—	346
Nigeria	V.D. Clinic, Military Hospital, Ibadan	1944 (6 months)	18	43	27
Somaliland	Government hospitals and dispensaries	1946/52	14,831	19,784	1,627
Southern Rhodesia	V.D. Clinic, Infectious Diseases Hospital, Salisbury	1949 (sample)	140	76	94
Swaziland	V.D. Clinics, Salisbury	1950/52	1,863	3,214	3,252
	Government hospitals and dispensaries	1946/52	26,687	9,715	45
Tanganyika	V.D. Clinic, Dar-es-Salaam	1951/52	2,747	4,567	839
Uganda	African Hospital, Mulago	1936/7	663	852	384

Additional replies from Sierra Leone, the Union of South Africa and South West Africa confirm the existence of chancroid in these territories, but, although further information is being collected, no figures are yet available as to incidence, because the condition is grouped under "Other V.D."

Chancroid also affects white-skinned persons, but information is to hand only from a few territories (Table 2).

Table 2. *Chancroid in Europeans*

Territory	Source of figures	Year	Syphilis	Gonorrhœa	Chancroid
Belgian Congo	Government medical services	1951	81	547	23
Gold Coast	V.D. Clinic, Military Hospital, Accra	1944	18	162	36
Uganda	European Hospital, Kampala	1936/7	14	12	1

That chancroid may become a problem greater than syphilis in white-skinned persons under military conditions has been illustrated in the U.S. Navy in 1951, which was principally engaged in the Far East. To 10,089 cases of gonorrhœa, and only 147 of syphilis, there were no less than 4,813 cases of chancroid in a total strength of 65,000 (4).

Among United Nations forces in Korea chancroid has been the commonest venereal disease, the ratio of chancroid to gonorrhœa to syphilis being 14 : 8 : 1



in white troops and 21 : 11 : 1 in negro troops (1). Although the condition is said to affect white-skinned persons less commonly than negroes, this is evidently less so when both races are exposed to the same sexual risks. The difference in susceptibility sometimes apparent is more likely to be due to hygienic rather than to racial factors.

In the following tables the ratio in a number of territories of chancroid to the other venereal diseases has been calculated, and the countries are grouped in the respective order of incidence.

Table 3. *Ratio of chancroid to gonorrhœa in a number of African territories*

Territory	Source of figures	Year	Gonorrhœa	Chancroid	Cases of gonorrhœa to one of chancroid
<b>AFRICANS</b>					
Southern Rhodesia	V.D. Clinic, Infectious Diseases Hospital, Salisbury	1949 (sample)	76	94	0.8
Nigeria	V.D. clinics, Salisbury	1950/52	3,214	3,252	1.0
	V.D. Clinic, Military Hospital, Ibadan	1944 (6 months)	43	27	1.6
Uganda	African Hospital, Mulago	1936/7	852	384	2.2
Gold Coast	V.D. Clinic, Military Hospital, Accra	1943/4	2,414	789	3.1
Tanganyika	V.D. Clinic, Dar-es-Salaam	1951/2	4,567	839	5.4
French Dahomey	Government hospitals and dispensaries	1950/51	10,082	1,221	8.3
French Somaliland	ditto	1951/2	2,211	253	8.7
Bechuanaland	ditto	1950	2,554	290	8.8
Somaliland	Government hospitals	1946/52	19,784	1,627	12.2
Kenya	V.D. Clinic, Infectious Diseases Hospital, Nairobi	1949/51	8,801	679	12.9
French Cameroons	Government clinics and dispensaries	1939/52	688,200	25,422	27.1
Northern Rhodesia	In-patients, government hospitals	1947/50	4,635	165	28.1
Basutoland	Government hospitals and dispensaries	1950/51	3,773	51	73.9
Belgian Congo	ditto	1948/51	223,475	1,417	157.7
Swaziland	ditto	1946/52	9,715	45	215.9
<b>EUROPEANS</b>					
Gold Coast	V.D. Clinic, Military Hospital, Accra	1944	162	36	4.5
Uganda	European Hospital, Kampala	1936/7	12	1	12.0
Belgian Congo	Government hospitals	1951	547	23	23.8

It is noted that the highest incidence of chancroid tends to be reported from hospitals with venereal diseases departments which are accustomed to recognizing the condition.

A closer study of the figures from some territories indicates a striking increase in recent years in the number of cases of gonorrhœa treated (Table 4). This increase is doubtless related to the simplicity of the newer treatments whereby persons who were at one time in hospital for long periods of time with a chronic gonorrhœa are now able to attend with several infections during the same year.

Table 4. *Rise in numbers of cases of gonorrhœa treated in a number of African territories*

Territory	Source of figures	Year			
		1949	1950	1951	1952
French Cameroons	Government clinics and dispensaries	(1946 = 47,654)	90,656	93,785	—
French Dahomey	ditto	—	4,489	5,593	—
French Somaliland	ditto	—	—	791	1,420
Kenya	Infectious Diseases Hospital, Nairobi	2,771	2,900	3,130	—
Somaliland	Government clinics and dispensaries	3,303	3,796	4,045	5,496
Swaziland	ditto	1,296	1,761	1,934	2,096
Tanganyika	V.D. Clinic, Dar-es-Salaam	—	1,155	1,740	2,827

Table 5. *Ratio of chancroid to total syphilis in a number of African territories*

Territory	Source of figures	Year	Syphilis	Soft sore	Cases of syphilis to one of chancroid
AFRICANS					
Gold Coast	V.D. Clinic, Military Hospital, Accra	1943/4	238	789	0.3
Southern Rhodesia	V.D. Clinic, Native Infectious Diseases Hospital, Salisbury	1950/52	1,863	3,252	0.6
	V.D. clinics	1949 (sample)	140	94	1.5
Nigeria	Military Hospital, Ibadan	1944 (6 months)	18	27	0.7
Uganda	African Hospital, Mulago	1936/7	663	384	1.7
Tanganyika	V.D. Clinic, Dar-es-Salaam	1951/2	2,747	839	3.3
French Somaliland	Government clinics and dispensaries	1951/2	1,351	253	5.3
Somaliland	Government hospitals and dispensaries	1946/52	14,831	1,627	9.1
Kenya	V.D. Clinic, Infectious Diseases Hospital, Nairobi	1949/51	6,749	679	9.9
French Dahomey	Government hospitals and dispensaries	1950/51	24,600	1,221	20.1
French Cameroons	ditto	1939/52	699,073	25,422	28.9
Bechuanaland	ditto	1950	9,179	290	31.6
Belgian Congo	ditto	1948/51	58,687	1,417	41.4
Northern Rhodesia	ditto	1947/50	12,168	165	73.7
Basutoland	ditto	1950/51	11,683	51	229.1
Swaziland	ditto	1946/52	26,687	45	593.0
EUROPEANS					
Gold Coast	V.D. Clinic, Military Hospital, Accra	1944	18	36	0.5
Belgian Congo	Government hospitals	1951	81	23	3.5
Uganda	European Hospital, Kampala	1936/7	14	1	14.0

The figures for syphilis in the preceding table refer to total syphilis. The numbers of cases of primary syphilis for a few territories are shown in Table 6 and it is noted that in a number the incidence of chancroid even exceeds that of primary syphilis.

Table 6. *Ratio of chancroid to primary syphilis in a number of African territories*

Territory	Source of figures	Year	Primary syphilis	Chancroid	Cases of primary syphilis to one of chancroid
AFRICANS					
Uganda	African Hospital, Mulago	1936/7	163	384	0.4
Southern Rhodesia	V.D. Clinic, Infectious Diseases Hospital, Salisbury	1949 (sample)	75	94	0.8
French Dahomey	Government hospitals and dispensaries	1950/51	1,127	1,221	0.9
French Somaliland	ditto	1951/2	279	253	1.1
Bechuanaland	ditto	1950	2,232	290	7.7
Basutoland	ditto	1950/51	2,147	51	42.1
Swaziland	ditto	1952	479	1	479.0
EUROPEANS					
Uganda	European Hospital, Mulago	1936/7	3	1	3.0

A closer examination of the syphilis figures, broken down as to stage of disease, reveals a reported incidence of hereditary syphilis in French Dahomey which is much higher than in other parts of Africa (Table 7). Although the picture may be confused by yaws, or by the method by which the statistics are compiled, it would be worth while looking for a focus of extra-venereal syphilis in this area.

Table 7. *Reported syphilis in French Dahomey*

Stage of disease	1950	1951	Total
Congenital syphilis	3,858	4,075	7,933
Early syphilis	723	404	1,127
All other forms	4,844	10,696	15,540
	9,425	15,175	24,600
Percentage of congenital syphilis to total syphilis	40.9	26.9	32.2

Information concerning lymphogranuloma venereum, granuloma inguinale and non-gonococcal urethritis in Africa is even more scanty and is given in the following tables. With few exceptions the reported cases of chancroid exceed the reported cases of each of these three diseases.

Table 8. *Ratio of chancroid to lymphogranuloma venereum (L.G.V.) in a number of African territories*

Territory	Source of figures	Year	L.G.V.	Chancroid	Cases of L.G.V. to one of chancroid
AFRICANS					
French Dahomey	Government hospitals and dispensaries	1950/51	23	1,221	0.02
Southern Rhodesia	V.D. Clinic, Infectious Diseases Hospital, Salisbury	1949 (sample)	12	94	0.1
French Cameroons	Government clinics and dispensaries	1939/52	4,943	25,422	0.2

Table 8—*continued*

Territory	Source of figures	Year	L.G.V.	Chancroid	Cases of L.G.V. to one of chancroid
<b>AFRICANS</b>					
Nigeria	V.D. Clinic, Military Hospital, Ibadan	1944 (6 months)	11	27	0.4
French Somaliland	Government hospitals and dispensaries	1951/2	123	253	0.5
Gold Coast	V.D. Clinic, Military Hospital, Accra	1943/4	523	789	0.7
Belgian Congo	Government hospitals and dispensaries	1951	393	371	1.1
<b>EUROPEANS</b>					
Belgian Congo	Government hospitals and dispensaries	1951	17	23	0.7
Gold Coast	V.D. Clinic, Military Hospital, Accra	1944	25	36	0.7

Table 9. *Ratio of chancroid to granuloma inguinale in a number of African territories*

Territory	Source of figures	Year	Granuloma inguinale	Chancroid	Cases of granuloma inguinale to one of chancroid
<b>AFRICANS</b>					
Gold Coast	V.D. Clinic, Military Hospital, Accra	1943/4	0	789	—
Southern Rhodesia	V.D. Clinic, Infectious Diseases Hospital, Salisbury	1949 (sample)	1	94	0.01
Uganda	African Hospital, Mulago	1936/7	6	384	0.02
Bechuanaland	Government hospitals and dispensaries	1949/50	2	290	0.07
Basutoland	ditto	1950/51	16	51	0.3

Table 10. *Ratio of chancroid to non-gonococcal urethritis in a number of African territories*

Territory	Source of figures	Year	N.G.U.	Chancroid	Cases of N.G.U. to one of chancroid
<b>AFRICANS</b>					
Southern Rhodesia	V.D. Clinic, Infectious Diseases Hospital, Salisbury	1949 (sample)	3	94	0.03
Gold Coast	V.D. Clinic, Military Hospital, Accra	1943/4	193	789	0.24
<b>EUROPEANS</b>					
Gold Coast	V.D. Clinic, Military Hospital, Accra	1944	59	36	1.6

## SKIN TEST FOR CHANCROID

The Ito-Reenstierna skin reaction, using a vaccine of *Hæmophilus ducreyi*, which takes 8-24 days after the appearance of the sore to become positive and

may remain so for life, is of uncertain value in the diagnosis of the individual case of chancroid. Thus only 55 per cent. of 1,402 known cases of chancroid in Korea reported by Asin (1953) (1) gave a positive reaction at the first visit. Mass skin testing, on the other hand, is of considerable help in determining the general incidence of chancroid, but so far few accounts of mass skin testing have been reported from the African continent, although 1,022 tests personally performed in the Gold Coast and in Southern Rhodesia have been reported (18) (24) (27). The results are summarized in Table 11.

Table 11. *Skin tests for chancroid in Africa*

		Number tested	Number positive	Percentage positive
<b>GOLD COAST</b>				
Accra ... ..	Chancroid patients	10	9	90.0
Accra ... ..	Other V.D. patients	22	10	45.5
<b>SOUTHERN RHODESIA</b>				
Salisbury ... ..	Male chancroid patients	32	20	62.5
Salisbury ... ..	Male V.D. patients	290	129	44.5
Bulawayo ... ..	Male V.D. patients	66	12	18.2
Salisbury ... ..	Male African troops	168	41	24.4
Rural areas ... ..	Male hospital patients	61	4	6.6
Salisbury ... ..	Female prostitutes	90	35	38.9
Rural areas ... ..	Female hospital patients	150	7	4.7
Salisbury ... ..	Children, urban clinics	14	5	35.7
Rural areas ... ..	Children, rural clinics	119	6	5.0
		1,022	278	27.2

It is noted that only 42 of the 1,022 patients of this series were known to have chancroid and yet the over-all positivity rate was 27.2 per cent. It is also noted that the incidence of positive skin tests was considerably higher in the towns where the incidence of the other venereal diseases was high, and low in the rural areas where the other venereal diseases were less often encountered.

It is felt that such skin testing, if done in other parts of Africa, would give much more reliable information concerning the incidence of chancroid than is suggested by a study of the annual returns. The skin test, in determining to some extent the general level of venereal disease, is a helpful index also when a focus of endemic syphilis is suspected. A low gonorrhœa rate and a low incidence of positive skin tests for chancroid are valuable corroborative indications that the focus may be asexual in nature.

#### DIAGNOSIS OF CHANCROID

Under favourable conditions the causative organism, *H. ducreyi*, may be identified in stained smears or cultures. The usefulness of smear diagnosis is limited as the bacillus is not easily recognized among the masses of bacteria usually encountered in genital lesions in Africans, and morphologically similar organisms may be seen in smears from syphilitic chancres and in females even



when no lesion is present. The organism can be grown on artificial media, but this is an impracticable procedure in most parts of Africa even if it were worth while.

At Salisbury, Southern Rhodesia (18), some 570 smears taken from 243 males were examined for *H. ducreyi*. Organisms morphologically resembling the bacillus were noted in 257 smears from 144 patients, the final diagnoses of which, after appropriate tests, were :

Chancroid	...	...	75
Primary syphilis	...	...	65
Granuloma inguinale	...	...	1
Balanitis	...	...	3

The limitations of the skin test in the diagnosis of the individual case have already been stated.

The diagnosis of chancroid is essentially one of exclusion, the exclusion of syphilis. Thus at least three daily dark-field examinations for *Treponema pallidum* should be obtained, and the serum tests for syphilis should be repeatedly observed over a period of three months, before syphilis can finally be excluded as the cause of the sore.

Such a regimen is not generally possible in Africa owing to (a) lack of equipment and (b) the tendency of the African to default. Even if (a) was rectified the objections of (b) would remain. Thus a treatment which is effective in both chancroid and syphilis is necessary for bulk treatment in Africa so that, bearing in mind that much of the diagnosis is in the hands of semi-skilled personnel, all cases of genital sore can be treated in a similar manner with reasonable hopes of success.

#### TREATMENT OF CHANCROID

Partly due to the lack of the dark-field microscope and the possibility of follow-up, and partly because of the desirability of having a rule-of-thumb method suitable for performance by native orderlies, it has been the practice in many parts of Africa to treat all cases of genital sores with weekly or bi-weekly injections of neoarsphenamine. This drug is practically ineffective in chancroid although sores do ultimately heal with its use. Such treatment, therefore, has little to recommend it today (25).

When the diagnosis of chancroid is reasonably certain, the sulphonamides are perhaps the drugs of choice as they are cheap and effective but have no effect upon co-existent syphilis. Of 100 male Africans treated by the author with sulphonamides in the Gold Coast the average in-patient time was 12.5 days, whereas in 94 others treated in Southern Rhodesia the average in-patient time was 12.7 days (28).

Streptomycin has been shown to be effective in both the experimental animal (9) (10) (30) and clinical (6) (7) (14) (15) (22) (30) infections, whereas good results have also been obtained with chlortetracycline (5) (12) (26) (30) (31) chloramphenicol (5) (26) (30) and oxytetracycline (11) (30).

The author has tested penicillin, streptomycin, chlortetracycline and chloramphenicol against experimental soft sore in man and has contrasted their action with those of the sulphonamides, neoarsphenamine, antimony and bismuth. This was done by three methods, all utilizing the fact that intradermal injections of fluid aspirated from a chancroidal bubo will, within 48-72 hours, produce a pustule which is followed by an ulcer at the site of injection unless effective drugs are immediately given. By the first method (19) patients were injected with their own bubo fluid prior to receiving some or no treatment. By the second method (20) the injections were made into others and the recipients were either treated with the drugs to be tested or left untreated as controls. In the third series of experiments the virulence of the bubo fluid was first established by injection into untreated controls. The donor was then treated with one of the drugs to be tested and, after 24-48 hours, bubo fluid was aspirated and inoculated intradermally into untreated persons to see whether or not it had lost its virulence (21).

The results of the 227 experiments are summarized in Table 12 (29) (30).

Table 12. *Experimental chancroid in man*

Treatment	Persons inoculated	"Takes"	No "takes"	Percentage "takes"
Nil (Controls)...	36	32	4	88.9
Sulphonamides ...	36	1	35	2.8
Streptomycin ...	21	0	21	nil
Aureomycin ...	24	2	22	8.3
Chloramphenicol ...	10	0	10	nil
Penicillin				
POB alone ...	32	0	32	nil
POB with sulpha	2	0	2	nil
PAM ...	21	9	12	42.8
Oral ...	4	1	3	25.0
Neoarsphenamine ...	38	25	13	65.8
(Bismuth) ...	(3)	(2)	(1)	66.6
same as NAB cases				
Antimony ...	3	3	0	100.0
	227	73	154	

Those receiving POB (penicillin in oil-beeswax) were given eight daily injections of 600,000 units, while those receiving penicillin orally had 400,000-600,000 units of calcium penicillin each day for 3-4 days.

Those given PAM (procaine penicillin with aluminium monostearate) received single injections of 2.4 mega units. Of 10 persons whose experimental inoculations took place within 0-4 days after receiving this treatment there were only 4 "takes," whereas of 11 persons receiving inoculations 5-8 days afterwards there were "takes" in no less than 7.

These results show conclusively that sulphonamides, streptomycin, chlortetracycline, chloramphenicol and penicillin in sustained dosage are all effective in preventing experimental chancroid in man, and in rendering the bubo fluid sterile. On the other hand, neoarsphenamine, bismuth and antimony are not.

Two facts are thus established: (a) That neoarsphenamine is bad treatment for soft sore; (b) that penicillin in the dosage given for syphilis is effective in preventing the experimental infection of chancroid.

There are only a few published reports (8) (13) concerning the effectiveness of penicillin in clinical chancroid. The "single shot" treatment for syphilis, using 2.4 mega units of PAM, was therefore put to the test under clinical conditions, and 99 consecutive African cases with penile sores were given this treatment (23) (28). Nineteen of these patients were thought definitely to have soft sores and all were fit for discharge from hospital in an average of 5.5 days. The sores of the other 80, on the grounds of dark-field or serum tests, or the presence of typical adenitis, were regarded as syphilitic although a mixed infection was considered probable in a large number. Of these only 12 were given additional treatment (oral sulphonamides in eight and local calomel ointment in four). In all only 11 (11.1 per cent.) of the 99 Africans with penile sores required sulphadiazine over and above the single injection of penicillin.

It is considered, therefore, that single injection treatments with penicillin are effective as a routine for both chancroid and chancre and that the sulphonamides may be reserved for those cases which fail to respond. The occasional cases which prove resistant may be granuloma inguinale.

### SUMMARY AND CONCLUSIONS

1. The incidence of chancroid in Africa is unknown, but under existing conditions the condition interferes materially with the economic life of the continent.

2. Reports of the numbers of cases of chancroid treated in the hospitals and dispensaries of a number of African territories are presented. For various reasons discussed the annual returns are not considered to be reliable indications of the true incidence of soft sore.

3. The highest reported incidence is from venereal diseases departments of hospitals with the necessary equipment and experience to recognize the condition, and a reported low incidence by no means indicates that the incidence is indeed low.

4. In such clinics the prevalence of chancroid may approach or even exceed that of primary syphilis. The available figures everywhere show chancroid to be more common than lymphogranuloma venereum, granuloma inguinale or non-gonococcal urethritis, although the reported figures for the latter three diseases are subject to the same reservations.

5. The best method of determining the prevalence of chancroid in an area is by skin test, although the value of this procedure is limited in the individual case. Results of 1,022 such tests performed in the Gold Coast and Southern Rhodesia are summarized. Predominantly negative skin tests for chancroid are a useful pointer to a scarcity of venereal disease in areas where endemic syphilis is suspected.

6. The diagnosis of chancroid is essentially one of the exclusion of syphilis

by repeated dark-field and serum tests. The means to do these are generally lacking and any sort of follow-up in the African is difficult to attain because of default. Methods of isolating *H. ducreyi* by smear and culture are of little value owing to the possibility of double infection with syphilis.

7. For these reasons, in the treatment of genital sores in Africans, it is necessary to have a drug which is effective in both chancroid and syphilis.

8. Clinical and experimental evidence is presented to show that penicillin is probably adequate for this purpose.

9. Although sulphonamides are effective and cheap for the established case of soft sore, penicillin becomes the drug of choice owing to the inherent difficulties of diagnosis. Sulphonamides should be given to the few patients whose sores fail to heal.

10. The growing activities against the treponematoses require a better understanding of the importance of chancroid in Africa if the results of the penicillin treatment of syphilis in that continent are to be properly assessed.

11. The figures presented also show a recent striking increase in the numbers of new African cases of gonorrhœa treated in a number of territories, and a high reported incidence of congenital syphilis in French Dahomey. The possible reasons for these phenomena are discussed.

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# TESTS OF BACTERIAL SENSITIVITY TO ANTIBIOTICS

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## INTRODUCTION

FOR the rational antibiotic treatment of patients suffering from bacterial infections a knowledge of the sensitivity of the causative micro-organism to the available drugs is required. This knowledge may come from previous experience or be determined in the laboratory. As examples of the former, pneumococcal pneumonia and hæmolytic streptococcal sore throat may be quoted. The organisms associated with these conditions are always penicillin sensitive. Laboratory tests are required when there is doubt as to the identity or the sensitivity of the infecting organism. If an organism whose sensitivity pattern is well known is isolated, sensitivity tests are not necessary but may be of interest. If the sensitivity of the organism is not known tests are performed. Whilst the *in vitro* tests of the reaction between the organism and the drug are not strictly comparable with their reaction *in vivo*, where other factors such as the natural resistance of the host play a part, they have been widely accepted, with a few exceptions, as a useful guide to treatment. In this paper we review the existing tests and recommend one suitable for use in a routine clinical laboratory. The sensitivity of *Mycobacterium tuberculosis* to various antibiotic and chemotherapeutic substances is not considered.

## TYPES OF TEST

The aim of these tests is to observe the effect on the organism of differing concentrations of the antibiotic. Numerous methods have been devised with this aim in view and are briefly described below.

### *Tube dilution method*

The antibiotic is diluted with a suitable fluid culture medium to form a series of known concentrations. The organism to be tested is inoculated into each tube, and into a control tube. After incubation the concentration of antibiotic which either inhibits or kills the organism is recorded. This method is, generally speaking, the most accurate, but as it is very laborious only a limited number of tests can be performed. It is not suitable for testing the penicillin sensitivity of penicillinase-producing staphylococci (Cruickshank, 1955).



*Solid media incorporating antibiotics*

One or more plates of solid media incorporating a known concentration of antibiotic are used. If an organism is inhibited, but grows on a control plate containing no antibiotic, it is considered sensitive. This method is wasteful, both of time and materials, for if only one organism is to be tested against five antibiotics, at least five carefully prepared plates will be required in addition to a control.

*Agar diffusion methods*

Many methods incorporating an agar diffusion technique are in use. The antibiotic is applied in a concentrated form to one part of a solid agar medium from which it diffuses into the surrounding medium. The concentration of drug gradually diminishes from the point of application outwards.

(a) *Ditch plate method.* This was the test originally used by Fleming (1929). A central ditch is removed from an agar plate and replaced by agar containing antibiotic. The organism to be tested is inoculated at right angles to the ditch. If, after incubation, the organism grows up to and over the ditch it is resistant, and if growth is inhibited near the ditch it is sensitive. A control organism is usually inoculated on to the same plate. A modification of this method uses a filter paper strip which, after being soaked in antibiotic solution, is laid on the plate. These methods have the disadvantage of requiring a separate plate for each antibiotic, which is wasteful if only a few organisms are to be tested.

(b) *Tablet method.* Small tablets containing antibiotics are obtainable commercially. These are placed on freshly inoculated plates and zones of inhibition noted after incubation. They are relatively expensive but are satisfactory for a qualitative test.

(c) *Cylinder plate method.* A plate is sown with the test organism and small sterile cylinders made of porcelain, glass or steel are pressed on to the surface of the medium. The cylinders are then filled with antibiotic solution and the plate is incubated. Sensitivity is shown by the failure of the organism to grow up to the cylinder. Holes bored in the medium can be used as an alternative. This method is more time consuming and exacting than the paper disc techniques which employ the same principle.

(d) *Paper disc method.* Paper discs, which have been impregnated with antibiotic solutions, are placed on an agar plate after it has been sown with the test organisms. After incubation the sensitivity of the organism is judged by the zone, if any, of inhibition of growth surrounding the disc. As this method is both economical and easy to perform, we consider it is the most suitable type of test for use in a routine clinical laboratory (see Plate I, facing page 38).

## ANTIBIOTIC PAPER DISCS

As recommendations for the preparation of the discs vary they will be considered in more detail.

*Choice of paper and size of disc*

An absorbent paper is required and both filter paper (Gould & Bowie,

1952) and blotting paper (Ungar, 1951) can be used. Discs may be cut out with a paper hole puncher or a cork borer. The cork borer method is tedious. We recommend an ordinary office paper punch (Stationery Office two-hole punch No. 803) which stamps out discs 6 mm. in diameter. Ungar (1951) recommends 9 mm. discs which will absorb 0.02 ml. of fluid. 0.01 ml. of fluid is absorbed by the 7 mm. filter paper discs recommended by Gould and Bowie (1952) and by the 6 mm. blotting paper discs which we have used. The use of a standard dropper (Ungar, 1951) which adds a constant volume of antibiotic solution to each disc, which is then dried, is time consuming and is unnecessary as 1 ml. of antibiotic solution is completely and evenly absorbed by 100 (6 mm.) blotting paper discs. This is demonstrated by Experiment 1.

*Experiment 1.* One ml. of a penicillin solution containing 200 units was added to 100 sterile discs. Plates were inoculated with a standard organism (*Staphylococcus aureus*, Oxford strain), and the discs (five to each plate) applied. After incubation for 18 hours the diameters of the zones of inhibition were measured. It was found that the diameters were 31.0 mm.  $\pm$  1 mm. (standard deviation 0.355).

#### *Identification of the discs*

Bowie & Gould (1952) recommend the use of Ford dyes which they incorporated into their filter paper discs. Coloured paper discs are available commercially. The dyes have no anti-bacterial action. We have found discs prepared from Ford blotting paper, already coloured, satisfactory. Different colours are reserved for the various antibiotic solutions. As the dyes are precipitated by streptomycin (Bowie & Gould, 1952) white discs are used for this antibiotic.

#### *Concentration of antibiotic per disc*

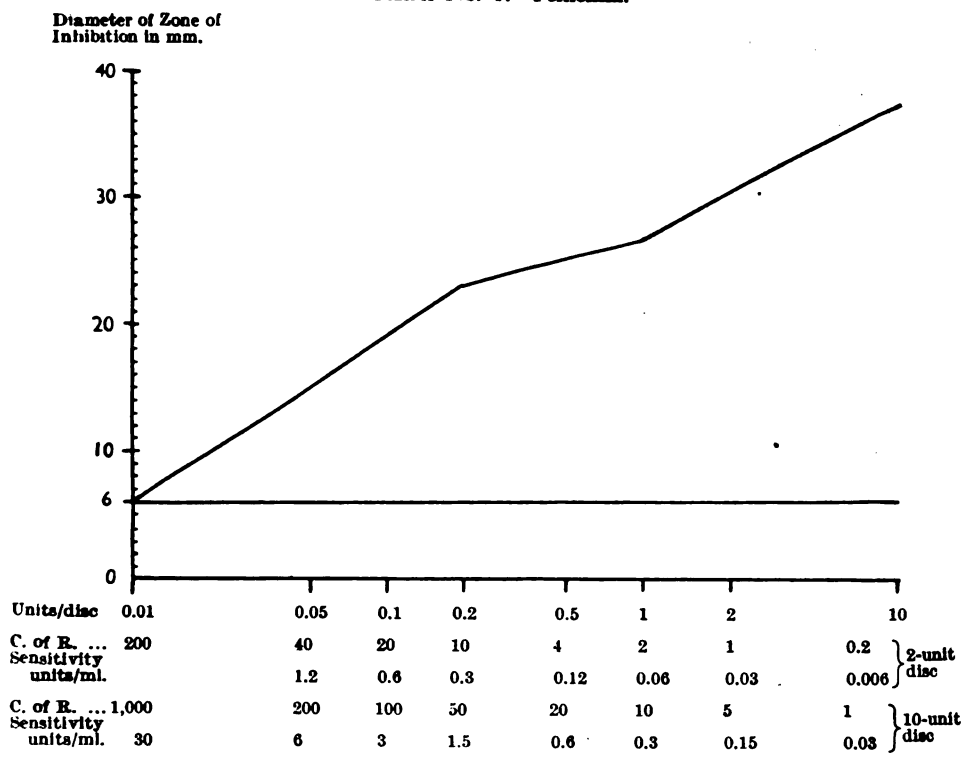
By using a standard technique and a standard organism (*Staph. aureus*, Oxford strain) the effect of using discs impregnated with varying concentrations of antibiotic can be measured and a graph constructed. From this a suitable concentration of antibiotic per disc can be chosen for routine work.

#### *Construction of the graphs*

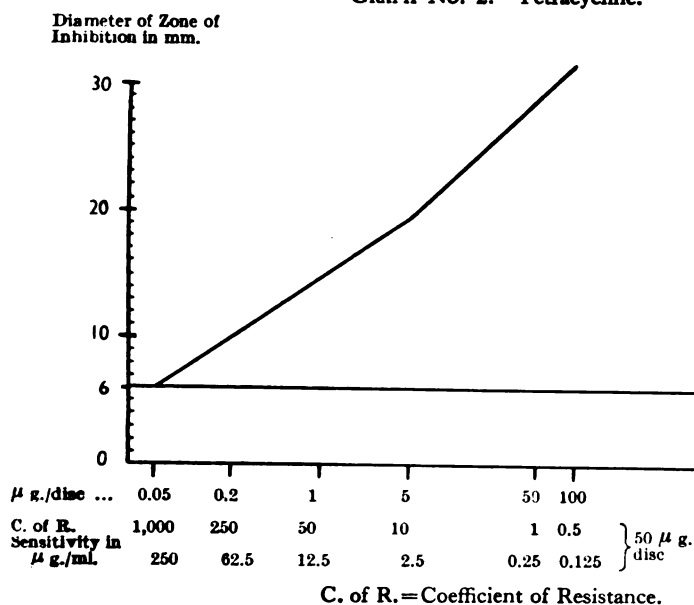
(a) *Benzylpenicillin.* Penicillin, obtained from the hospital dispensary, in the form of crystalline sodium penicillin G, was diluted with sterile distilled water to varying concentrations. 1 ml. of each concentration was added to 100 sterile discs and ten of each put up on plates inoculated with the standard organism. After 19 hours' incubation at 37° C. the diameters of the zones of inhibition were measured and plotted against the logarithm of the concentration of antibiotic per disc (Graph 1).

A two-unit disc giving a zone of 31 mm. with the standard organism was chosen for routine work. Using this disc, as described below, the antibiotic sensitivity of any test organism can be compared with the standard staphylococcus or recorded in units per ml. by measuring the zone of inhibition in millimetres and correlating it with the *abscissa* line indicating the Coefficient of Resistance

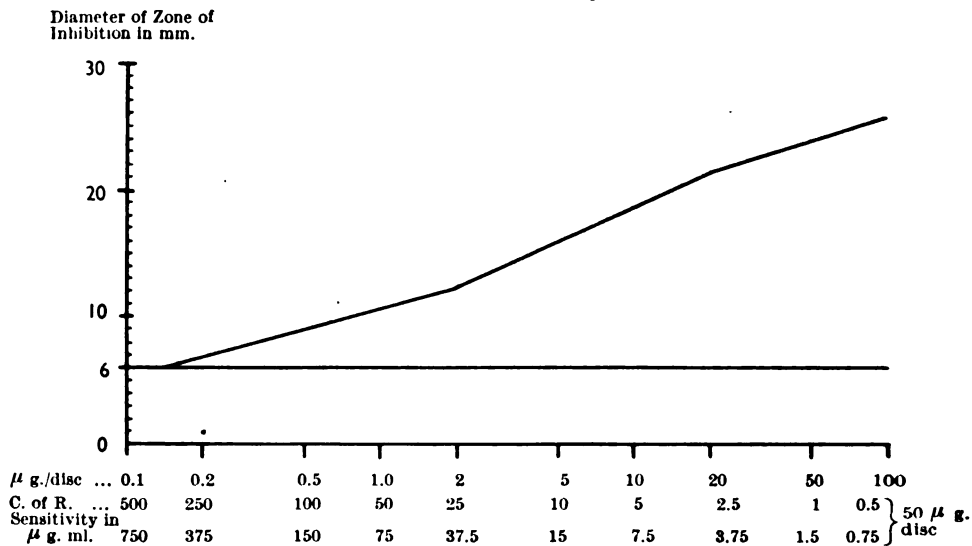
GRAPH No. 1. Penicillin.



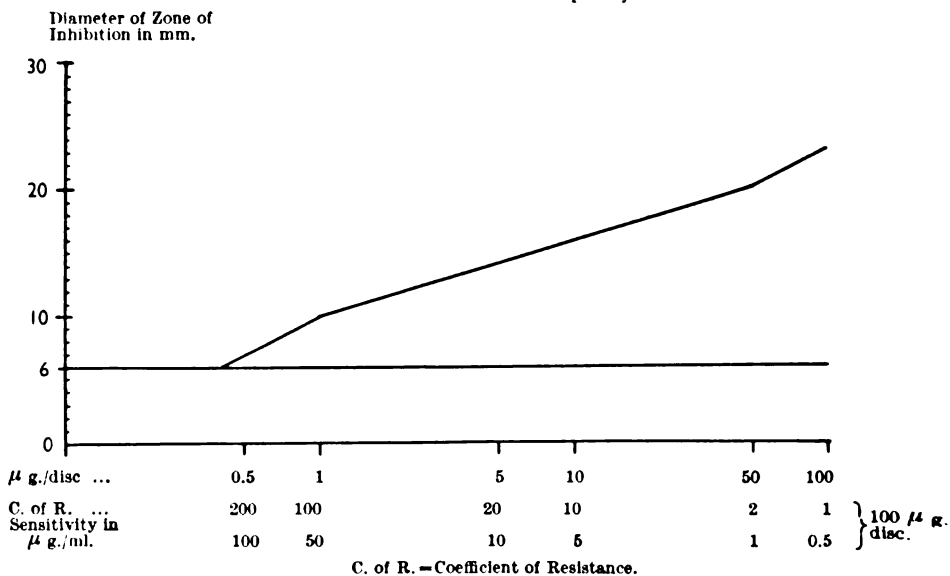
GRAPH No. 2. Tetracycline.



GRAPH NO. 3. Chloramphenicol.



GRAPH NO. 4. Streptomycin.



or Sensitivity in units per ml. The use of the graph in most cases, however, is not necessary as the relevant information can be obtained from Table 3.

The abscissæ—Coefficient of Resistance and Sensitivity in units per ml.—have been derived as follows (Gould, 1955): The standard organism gives a zone of inhibition of 31 mm. with a two-unit disc, and if the test organism also gives a zone of 31 mm. the sensitivities of the two organisms to penicillin are the same. The Coefficient of Resistance (*i.e.*, concentration required to inhibit test organism/concentration required to inhibit the standard organism) is 1. If, however, the diameter of the zone of inhibition of the test organism is 23 mm., reference to the graph shows that the standard organism requires only a 0.2 unit disc to give the same zone of inhibition, so we have  $C. of R. = 2/0.2 = 10$ . The sensitivity or minimum inhibitory concentration of the standard organism, as measured by the tube dilution technique, is 0.03 units per ml., and so the C. of R. can be converted into absolute sensitivity values by using the factor 0.03. Thus sensitivity equals  $C. of R. \times 0.03$ , in this case  $10 \times 0.03 = 0.3$  units per ml. The other figures are derived similarly.

(b) *Tetracycline*. The tetracycline was obtained from the manufacturers as the pure substance. After suitable dilution, discs of varying concentrations were prepared and used to obtain the data for the preparation of Graph 2. The sensitivity of the standard organism was found by the tube dilution method to be 0.25  $\mu$ g. per ml. and a 50  $\mu$ g. disc was chosen for routine use.

(c) *Chloramphenicol*. The chloramphenicol was obtained from the hospital dispensary in the form of oral capsules containing 250 mg. After suitable dilution, discs of varying concentrations were prepared and used to obtain the data for the preparation of Graph 3. The sensitivity of the standard organism was found by the tube dilution method to be 1.5  $\mu$ g. per ml. and a 50  $\mu$ g. disc was chosen for routine use.

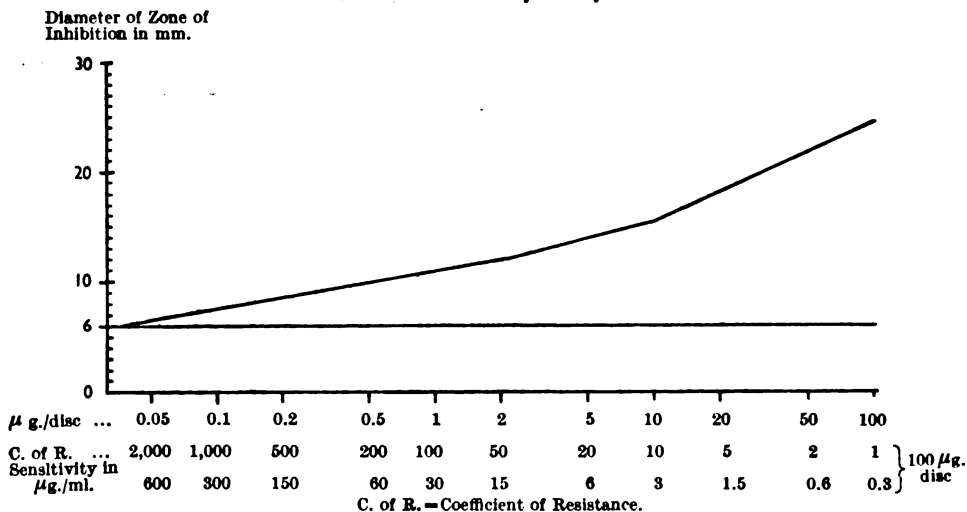
(d) *Streptomycin*. The streptomycin was obtained from the hospital dispensary in the form of "Streptoquine" Solution Stabilized Injection of Streptomycin Sulphate. After suitable dilution, discs of varying concentrations were prepared and used to obtain the data for the preparation of Graph 4. The sensitivity of the standard organism was found by the tube dilution method to be 0.5  $\mu$ g. per ml. and a 100  $\mu$ g. disc was chosen for routine use.

(e) *Erythromycin*. The erythromycin was obtained from the manufacturers as the pure substance. After suitable dilution, discs of varying concentrations were prepared and used to obtain the data for the preparation of Graph 5. The sensitivity of the standard organism was found by the tube dilution method to be 0.3  $\mu$ g. per ml. and a 100  $\mu$ g. disc was chosen for routine use.

#### *Factors affecting the zone of inhibition*

Various factors, apart from the actual sensitivity of the organism, may affect the diameter of the zone of inhibition and must be standardized if the test is to be used quantitatively. The size of the disc and the amount of antibiotic absorbed have already been mentioned and no errors should arise from these factors.

GRAPH NO. 5. Erythromycin.



Storage of the discs at 4° C. does not result in any appreciable loss of potency as is illustrated in Experiment 2.

**Experiment 2.** Fifty discs of each antibiotic of routine concentration were made up and stored at 4° C. Each week the discs were placed on plates inoculated with the standard organism and after incubation for 18 hours the diameters of the zones of inhibition were recorded. During the three months the penicillin, streptomycin and erythromycin discs showed no deterioration, the zones of inhibition remaining constant. The tetracycline and chloramphenicol discs showed a slow deterioration, the zone of inhibition after three months being 2 mm. less than when the discs were freshly prepared.

The size of the inoculum is important, but by the methods described below a confluent growth is obtained and no appreciable variation in the size of the zone of inhibition occurs. If necessary the number of organisms in the inoculum can be standardized to 100 million per ml. The tests should be read after 18 hours' incubation so that the time of incubation is constant. Variations within the pH range 7.2-7.6 have no appreciable effect. The medium should contain 2 per cent. agar, and 5 per cent. blood agar plates are recommended for routine sensitivity tests. The depth of the medium is important and the graphs have been constructed using plates about 2 mm. deep. If the plates are prepared by adding 10 ml. of medium to each four-inch petri dish, this gives a depth of approximately 2 mm. and so the factor remains constant. Primary plates used for the isolation of the organism are often deeper; if antibiotic discs are used at this stage a qualitative answer only is possible and further tests on a subculture should be carried out. Useful information can often be obtained by using a penicillin disc in the well of all primary plates.

## TECHNIQUE OF RECOMMENDED TEST

*Preparation and storage of the discs*

Discs are punched out of Ford blotting paper, of the appropriate colour, obtainable from any stationers. One hundred are carefully counted out, placed in a universal container and sterilized in the hot air oven at 160° C. for one hour. When the discs are cool 1.0 ml. of the appropriate concentration of antibiotic solution is added and the bottle vigorously shaken to ensure equal distribution of solution. The discs are then ready for use. The colours and concentrations used are given in Table 1. Provided the other factors affecting the zone of inhibition remain constant, the discs can be used with the graphs we have prepared. However, we have found that erythromycin supplied for laboratory use varies in potency and so it is advisable to prepare a graph for each new batch received. The discs are stored at 4° C. and will retain their potency for at least three months (Experiment 2).

Table 1. *The colour and strength of antibiotic discs*

Antibiotic	Colour of disc	Amount of antibiotic	
		Per ml. (stock)	Per disc
Benzyl-penicillin ...	Purple	200 units (133 µg.)	2 units (1.3 µg.)
Tetracycline ...	Yellow	5 mg.	50 µg.
Chloramphenicol ...	Green	5 mg.	50 µg.
Streptomycin ...	White	10 mg.	100 µg.
Erythromycin ...	Red	10 mg.	100 µg.

*Use of the discs*

The tests are best carried out on a young pure subculture of the test organism, although in certain cases the discs can be used to give an early indication of the sensitivity on the primary culture.

(a) A sweep of several colonies of the test organism is subcultured into a nutrient broth and incubated for several hours. The culture is then poured on to the surface of a blood agar plate (nutrient agar and McConkey agar can also be used) and the excess removed with a sterile pasteur pipette into lysol. The plates are then dried in the incubator for one hour and the discs applied, using forceps with fine points which are kept in 70 per cent. alcohol and flamed before use. The discs should be placed around the periphery of the plate, 20 mm. from the edge and spaced equidistantly. The plates are then incubated for 18 hours before reading.

(b) The test can also be carried out by taking a sweep of several colonies of the test organism and making a heavy, even inoculum over the whole surface of a blood agar plate. The discs are then applied as before and the plates are incubated for 18 hours before reading.

*Interpretation of results*

Simple qualitative results only are generally required by the clinician. It is necessary, however, to have some idea of the meaning of "sensitive" and



Table 2. *Antibiotic serum concentrations*  
*After Valentine (1955) and McCorry and Weaver (1955)*

Antibiotic	Loading dose	Maintenance dose	Peak blood levels
Streptomycin ...	1 g.	0.5 g. 6-hourly	20-40 $\mu$ g./ml.
Chloramphenicol ...	2-3 g.	0.5 g. 6-hourly	16-33 $\mu$ g./ml.
Chlortetracycline ...	1-2 g.	0.5 g. 12-hourly	1-3 $\mu$ g./ml.
Oxytetracycline ...	1-2 g.	0.5 g. 12-hourly	2-4 $\mu$ g./ml.
Tetracycline ...	1 g.	0.5 g. 6-hourly	2.15-5.5 $\mu$ g./ml.
Erythromycin ...	1 g.	0.5 g. 6-hourly	1-8 $\mu$ g./ml.

Table 3. *Interpretation of results of sensitivity tests*

Antibiotic	Zone in mm.	Sensitivity in units or $\mu$ g. per ml.	Description	Abbreviation
Penicillin (2-unit disc)	Greater than 23	Less than 0.3 units	Penicillin very sensitive	P.V.S.
	16-23	0.3-1.0 units	Penicillin sensitive	P.S.
	7-16	1.0-5 units	Penicillin slightly sensitive	P.S.S.
	Less than 7	More than 5 units	Penicillin resistant (to five units)	P.R. 5
Penicillin (10 unit disc)	Greater than 16	Less than 5 units	Penicillin slightly sensitive, sensitive or very sensitive. Use 2 unit disc	
	10-16	5-15 units	Penicillin resistant (to five units)	P.R. 5
	Less than 10	More than 15 units	Penicillin resistant (to fifteen units)	P.R. 15
Tetracycline (50 $\mu$ g. disc)	Greater than 20	Less than 2.5 $\mu$ g.	Tetracycline sensitive	T.S.
	15-20	2.5-12.5 $\mu$ g.	Tetracycline relatively resistant	T.R.R.
	Less than 15	More than 12.5 $\mu$ g.	Tetracycline resistant	T.R.
Chloramphenicol (50 $\mu$ g. disc)	Greater than 17	Less than 10 $\mu$ g.	Chloramphenicol sensitive	C.S.
	14-17	10-25 $\mu$ g.	Chloramphenicol relatively resistant	C.R.R.
	Less than 14	More than 25 $\mu$ g.	Chloramphenicol resistant	C.R.
Streptomycin (100 $\mu$ g. disc)	Greater than 14	Less than 10 $\mu$ g.	Streptomycin sensitive	S.S.
	10-14	10-50 $\mu$ g.	Streptomycin relatively resistant	S.R.R.
	Less than 10	More than 50 $\mu$ g.	Streptomycin resistant	S.R.
Erythromycin (100 $\mu$ g. disc)	Greater than 20	Less than 1.0 $\mu$ g.	Erythromycin sensitive	E.S.
	13-20	1.0-8 $\mu$ g.	Erythromycin relatively resistant	E.R.R.
	Less than 13	More than 8 $\mu$ g.	Erythromycin resistant	E.R.

"resistant" in terms of the concentration of antibiotic required to inhibit the growth of the organism (abscissa of graphs), and to correlate this with the concentration of antibiotic obtained in the serum during treatment (Table 2). If the organism grows right up to the disc it is resistant to the drug; if there is a wide zone of inhibition the organism is sensitive or very sensitive. If a small zone of inhibition is seen the organism is regarded as "relatively resistant" or "slightly sensitive." Measuring the actual diameter of the zone of inhibition with a pair of dividers allows a quantitative result to be given. The exact con-

centration of antibiotic required to inhibit the organism can be read off the graphs, but this is not generally necessary. Table 3, which has been derived from the graphs, correlates the diameter of the zones of inhibition with the inhibitory concentrations of the antibiotic and the terminology used. By using this table the clinician will know more exactly what "sensitive" and "resistant," which are purely relative terms, actually mean. In the case of penicillin four grades of sensitivity are given. The "penicillin very sensitive" organisms are inhibited or killed by 0.3 units of penicillin per ml., a concentration readily obtained in the serum with doses as low as 100,000 units four-hourly or 100,000 units of crystalline penicillin with 300,000 units of procaine penicillin twelve-hourly. The "penicillin sensitive" organisms are inhibited by the usual doses of penicillin, but higher doses, repeated more frequently, are required for the "penicillin slightly sensitive" organisms. The organisms labelled "penicillin resistant 5" are not usually treated with penicillin as very large doses are required to provide a serum concentration greater than 5 units/ml. If necessary, however, the organism can be tested with a stronger penicillin disc containing 10 units, which will allow sensitivities equivalent to 15 units per ml. to be read. With the other drugs the usual clinical doses give rise to serum levels which will inhibit the organisms found "sensitive." Higher than usual doses may be required to inhibit the organisms found "relatively resistant" and are given only if the organism is not sensitive to any other drug.

#### OXYTETRACYCLINE, CHLORTETRACYCLINE, BACITRACIN, POLYMYXIN B AND NEOMYCIN

##### *The Tetracyclines*

Tetracycline itself is used to prepare the discs, and the sensitivities derived from their use apply, in the vast majority of cases, also to oxytetracycline (terramycin) and chlortetracycline (aureomycin). Discs can, if necessary, be made from these substances, using the same technique as for tetracycline. Discs containing chlortetracycline, which is less stable than tetracycline, do not keep so long.

##### *Bacitracin, Polymixin B and Neomycin*

Bacitracin, polymixin B and neomycin sensitivity tests are seldom requested and graphs have not been prepared. A qualitative test can be done by dipping one sterile disc into a solution containing bacitracin (1,000 units/ml.) or polymixin B (1,000  $\mu\text{g.}/\text{ml.}$ ) and using the disc as above. A suitable concentration for neomycin sulphate is 1,000  $\mu\text{g.}$  per disc which gives a zone of 27 mm. with the standard organism.

#### EXAMPLES OF RESULTS OBTAINED WITH THE METHOD DESCRIBED

The sensitivity pattern of fifty strains of *Staph. aureus* (coagulase positive) isolated from the patients and staff of the Royal Herbert Hospital was tested by the method described. The following results were obtained:

- (a) Benzylpenicillin—Very sensitive, 38 per cent. ; sensitive, 18 per cent. ; slightly sensitive, 22 per cent. ; resistant, 22 per cent.

- (b) Tetracycline—Sensitive, 60 per cent. ; relatively resistant, 28 per cent. ; resistant, 12 per cent.
- (c) Chloramphenicol—Sensitive, 100 per cent.
- (d) Streptomycin—Sensitive, 88 per cent. ; relatively resistant, 10 per cent. ; resistant, 2 per cent.
- (e) Erythromycin—Sensitive, 100 per cent.

### SUMMARY

An antibiotic sensitivity test using a paper disc technique is described. The discs are easy to prepare and the test is simple to perform. The results which are recorded qualitatively are correlated with inhibitory concentrations of the antibiotic. The antibiotic sensitivity pattern of fifty strains of *Staph. aureus* is recorded.

### ACKNOWLEDGMENTS

We wish to thank Lieutenant-Colonel P. D. Stewart for advice and for reading the manuscript, and also Messrs. Eli Lilly & Co. Ltd. for the supply of "Ilotycin" (Erythromycin), Lederle Laboratories Division, Cyanamid Products Ltd. for supply of "Achromycin" (Tetracycline), and Messrs. E. R. Squibb & Sons for the supply of neomycin sulphate.

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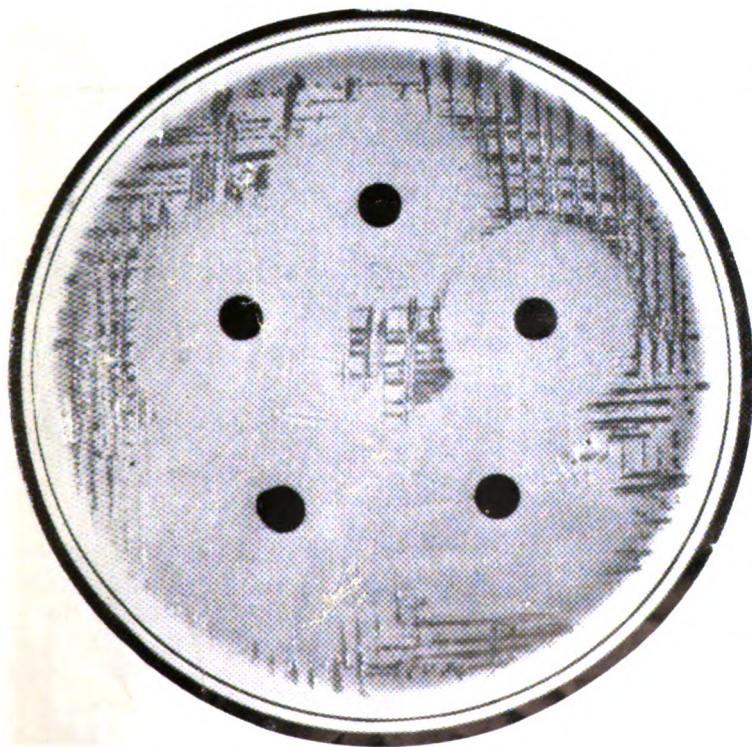


FIG. 1. Standard *Staph. aureus* : T.S., C.S., S.S., E.S., P.V.S.

The discs in both photographs, reading clockwise, contain tetracycline (12 o'clock), chloramphenicol, streptomycin, erythromycin and penicillin.



FIG. 2. *Staph. aureus* isolated from the faces of a patient after treatment with chlorotetracycline : T.R., C.S., S.R., E.S., P.R.

The discs in both photographs, reading clockwise, contain tetracycline (12 o'clock), chloramphenicol, streptomycin, erythromycin and penicillin.

[Photographs kindly taken by Photographer, R.A.M. College

PLATE I



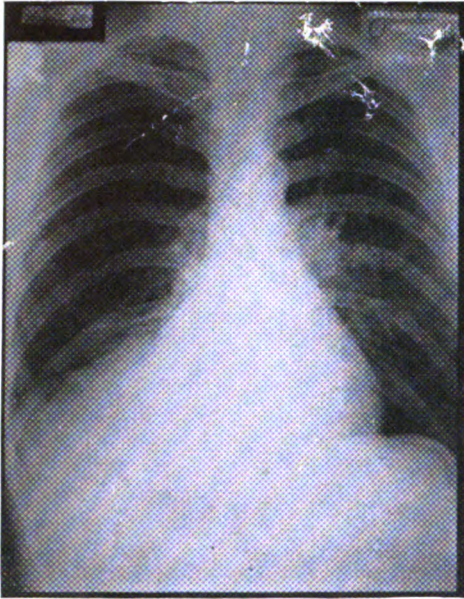


FIG. 1. P.A. radiograph of the chest.

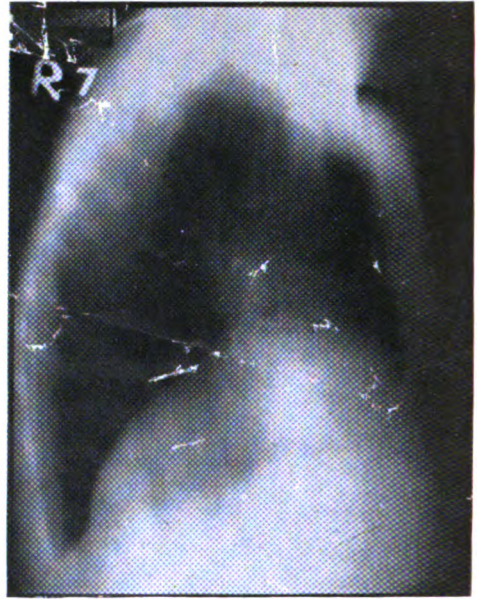


FIG. 2. Right lateral tomogram 7 cm. cut suggestive of raised right cupola of diaphragm.

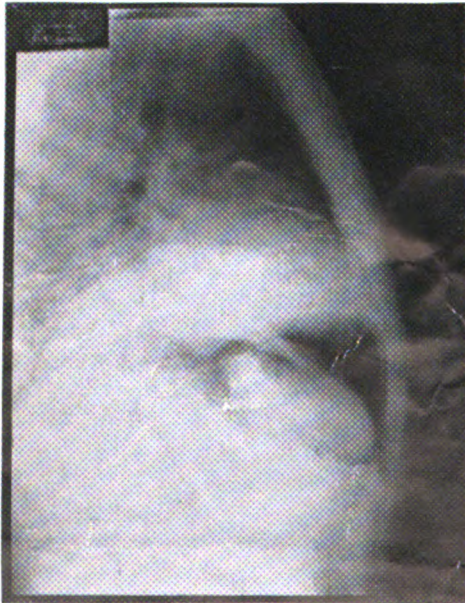


FIG. 3. Right lateral radiograph where diagnostic pneumoperitoneum reveals the mass to be supradiaphragmatic.

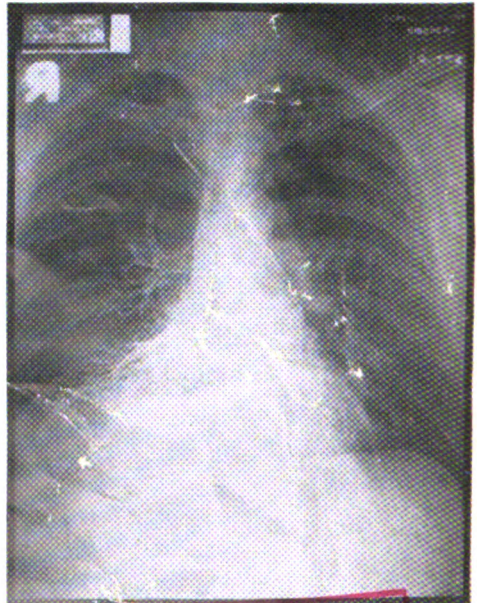
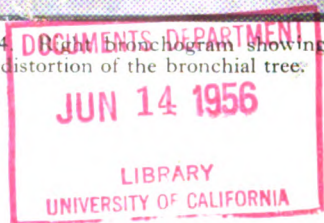


FIG. 4. Double bronchogram showing the distortion of the bronchial tree.

PLATE I



## LIPOTHYMOMA

A REPORT OF A CASE AND A REVIEW OF THE LITERATURE

BY

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LIPOTHYMOMA is a rare form of mediastinal tumour, and the occurrence of one at the Army Chest Centre prompted us to review the literature and to add this case.

A lipothymoma is a benign encapsulated tumour arising from the thymus in the anterior mediastinum and consisting of an admixture of thymic and adipose tissue. The term lipothymoma was coined by Houdard (1950) and later by Bigelow & Ehler (1952).

Clinically they have a variable presentation and symptomatology like mediastinal lipomas to which they are closely akin. On examination and radiologically they can be mistaken for pleural fluid; pulmonary atelectasis, cardiomegaly and pericardial effusion. They are not associated with any symptoms or signs of myasthenia. They undoubtedly arise in childhood or adolescence and because of their slow growth they can be found at any age and not, as stated by Rubin & Mishkin (1954), in children only.

### CASE REPORT

Sgt. L. D., a 36-year-old regular soldier, decided to have a chest radiograph while his squad of recruits were being examined by a M.M.R. unit in June, 1954. This M.M.R. film showed a shadow at the right base.

On 26.6.54 he was admitted to the Army Chest Centre with a diagnosis of "right lower lobe collapse." He was completely symptomless and had no complaints referable to the chest. There was nothing relevant in his past or family histories. He had never suffered from any tropical diseases.

On examination he was a well-developed and fit-looking man. Except for dullness and diminished breath sounds at the right base, no physical abnormalities were found. There were no myasthenic symptoms or signs.

*Routine investigations.* E.S.R.=2 mm. in 1st hour (Westergren): blood count within normal limits: Mantoux 1:1,000 positive: sputum tests negative for A.A.F.B. on smear and culture: liver function tests normal and stools normal.

**Radiographs.** P.A. film showed a triangular-shaped shadow to the right of the heart with the base blending with the liver and right hemidiaphragmatic shadows. The apex blended with the superior mediastinum and laterally it extended to the right costo-phrenic angle. The lateral part of the shadow was less dense than the medial. A right lateral radiograph showed a dome-shaped shadow inferiorly giving the appearance of a raised right hemidiaphragm with no evidence of a collapsed right lower lobe. Screening showed sluggish movement in normal direction of the upper concave border of the shadow.

Right lateral tomography confirmed the appearances seen on the lateral film of an apparently raised right hemidiaphragm.

A right bronchogram with 60 per cent. dionosil revealed displacement and thinning of the right middle and lower lobe bronchi over the shadow. The main stem bronchi were normal and unobstructed.

**Bronchoscopy** (by Mr. Kent Harrison). There was displacement laterally and posteriorly of the basal bronchi on the right side. The bronchial tree was otherwise normal.

**Diagnostic pneumoperitoneum.** The mass was shown to be above the right hemidiaphragm with downward displacement of the latter.

A pre-operative diagnosis of mediastinal lipoma was made.

**Operation on 31.8.54.** A right postero-lateral thoracotomy exposed a large encapsulated lobulated fatty mass occupying the medial and lower part of the right hemithorax. The right middle and lower lobes were compressed laterally by the tumour and were free from it. The mass was conical in shape with its base on the diaphragm and its apex extending as a pedicle into the superior mediastinum in front of the arch of the aorta. The pedicle contained blood-vessels which branched over the surface of the tumour beneath its covering of mediastinal pleura.

The tumour was easily mobilized from the diaphragm and pericardium and the pedicle divided between clamps. The large fatty tumour was then removed from the pleural cavity. The post-operative course was uneventful and underwater-seal drainage was required for 24 hours.

The chest radiograph one week after operation showed a triangular shadow in the right cardiophrenic angle. This "recurrence" of the shadow was probably due to a blood collection combined with delayed expansion of the lower and middle lobes which had been compressed for such a considerable period of time pre-operatively. This shadow gradually cleared over the next two weeks and the patient was fit for discharge from hospital.

**Pathology** (Dr. R. H. Thomlinson). "Macroscopic: A mass of fat measuring  $22 \times 16 \times 6$  cm. and weighing 1,142 g. It is covered by a thin layer of fibrous tissue (pleura) in which there are blood-vessels. At one point larger vessels enter the mass of tissue. Microscopic: Four out of six histological preparations taken at random from the mass of fat contain thymus tissue. In one of these, from the region where the large blood-vessels enter the mass, there is marked hyperplasia of the thymus tissue but the different types of cell are in their normal proportions."



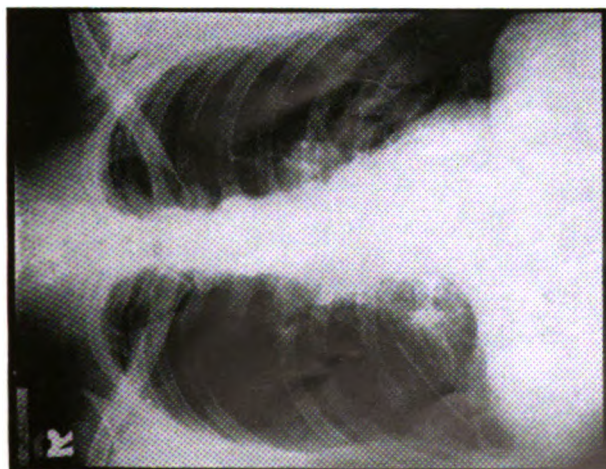


FIG. 1. P.A. radiograph of the chest during convalescence after the lipothymoma had been excised.

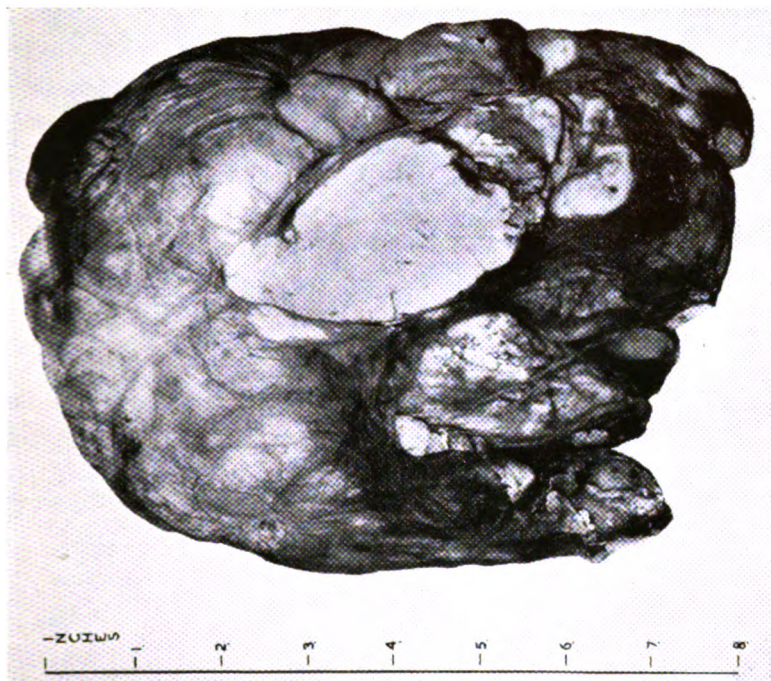


FIG. 2. Specimen removed at operation.

## PLATE II



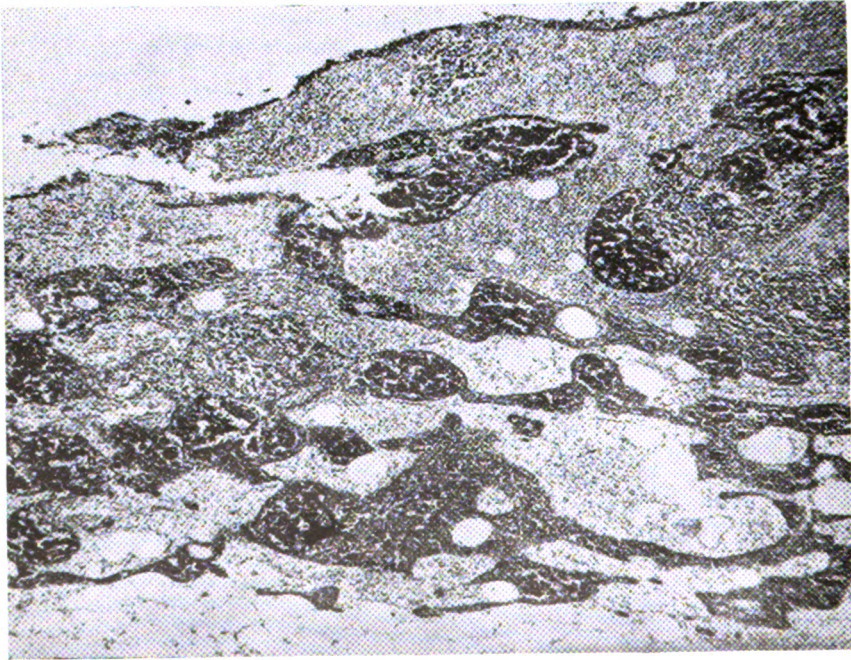


FIG. 1. Section of lesion showing Hassall's Corpuscles.

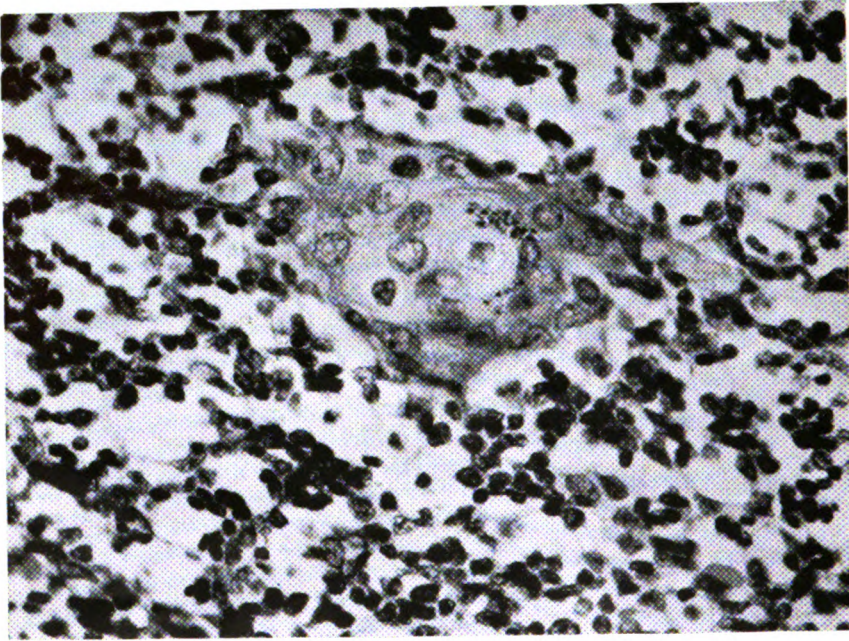


FIG. 2. Small area of section magnified to show a Hassall's Corpuscle to better advantage.

PLATE III

## REVIEW OF REPORTED CASES

1. Andrus & Foot (1937) reported the first case in a boy of 13 with increasing dyspnœa and cough. A large encapsulated lobulated mass weighing 2,235 g. with a pedicle to the anterior mediastinum was successfully removed from the left hemithorax. Microscopy showed a mixture of adipose and thymic tissue.

2. Schanher & Hodge (1949) described a case in a woman aged 35 with exertional dyspnœa, orthopnœa when lying on the right side and a wheezy dry cough. A radiograph ten years previously had shown an "enlarged heart." At operation a tumour weighing 625 g. was removed from the right hemithorax. It was attached to the anterior mediastinum in front of the aortic arch by a pedicle. Histologically it was a lipoma with centrally placed thymic remnants.

3. Bariety & Coury (1950) found one in a woman of 40 complaining of exertional dyspnœa and persistent dry cough for three years. Radiography and bronchography suggested a neoplastic obstruction and atelectasis of the right middle lobe. At operation a fatty lobulated tumour with a pedicle to the concavity of the aorta in front of the superior vena cava was found. It weighed 350 g. and consisted of lipomatous tissue in the midst of which were areas of thymic tissue.

4. Bariety & Coury quote a case described by Houdard (1950) whose report is not available for study.

5. Bigelow & Ehler (1952) found this unusual benign tumour in a girl aged 10 with cough and hæmoptysis. A 170 g. encapsulated tumour attached to the thymic area of the anterior mediastinum was removed from the right chest. Histologically it showed an admixture of fat and thymic tissue.

6. Grosse (1953) quotes a case in a male aged 14 found on a routine radiograph. At operation a fatty tumour was removed from the left hemithorax and it extended down from the left lobe of the thymus. It consisted of thymus and fat.

7. Rubin & Mishkin (1954) described one in a girl aged 19 with right chest pain on exertion and increasing dyspnœa. A radiograph at 14 years showed an "enlarged heart." An encapsulated lobulated mass with a pedicle to the thymic region was removed from the right chest at operation. The tumour weighed 750 g. and contained an admixture of thymus and fat.

## DISCUSSION

These cases and the one here reported have certain features in common. Lipothymomas arise in early life and in either sex and may be discovered at any age, as the process of involution does not eradicate all traces of thymic tissue but only reduces its amount. This will be shown by a study of the normal histology at varying ages.

They may be found on routine radiography or because of the symptoms of compression, *e.g.*, a dry, irritating cough and increasing exertional dyspnœa. In no case was there evidence of myasthenia. On radiography in all cases, the shadows were noted to be less dense peripherally and to be continuous with the

cardiac and diaphragmatic shadows. The intrathoracic position of the tumour can be confirmed by a diagnostic pneumoperitoneum and its extrapulmonary nature by bronchography and bronchoscopy. Pleuroscopy in one of the cases reviewed appeared to be of little help and in another angiocardigraphy was used.

At operation in all cases a lobulated mass of fat arising by a pedicle from the thymic area of the anterior mediastinum was found. Macroscopically the tumours had the typical appearance of a lipoma and on microscopy they contained thymic and adipose tissue in varying proportions. The younger the case the greater the amount of thymic tissue present. There was no evidence of malignancy in any of the cases.

A brief study of the normal development and histology of the thymus at varying ages helps in solving some of the problems of the pathogenesis and age incidence of these rare tumours and their possible relationship to mediastinal lipomas. The thymus is developed from the endoderm of the third bronchial pouch and migrates downwards through the superior mediastinum to its normal position in the anterior mediastinum in front of the aortic arch. Thymic rests may occur along this migration route and these may give rise to cervico-mediastinal and superior mediastinal thymic tumours.

Histologically the thymus at various age periods has the following features (after Hammar, 1921) :

1. Childhood (0-10 years)—Abundant parenchyma and sparse connective tissue.
2. Puberty (11-15 years)—Abundant parenchyma and wider septa of connective tissue.
3. Youth (16-20 years)—Reduction in parenchyma and broader strands of connective tissue and adipose tissue.
4. Adult (21-45 years)—Strands of parenchyma and connective tissue with much adipose tissue.
5. Old age (45 onwards)—Patchy parenchyma.

Briefly, then, the histological age pattern shows a gradual decrease in thymic parenchyma after puberty with an increase in adipose and connective tissue. Between the ages of 6 and 12 the thymus is at its maximum size; two-thirds consists of parenchyma, the rest of connective tissue and fat. After this the total size gradually decreases. At 20 years about half is parenchymatous and half fat and connective tissue, and between 30 and 40 years only about one-quarter to one-eighth is parenchymatous (Boyd, 1936).

This normal process of thymic involution occurs in lipothymomas and explains why the thymic elements are less marked in the older age group and may only be present as remnants in the pedicle or centre of the tumour. They can and do occur in adult life and not only in children, though they have probably originated in early life.

A mediastinal lipoma probably arises from the adipose tissue of the thymus and may originate as a lipothymoma which, when it undergoes involution of the thymic element, leaves the fatty element persisting as a lipoma (Rubin &

Mishkin, 1954). It may be, however, that if these lipomas were thoroughly examined microscopically, thymic elements would be found in varying amounts according to age. These mediastinal lipomas would in reality be lipothymomas.

These tumours may be localized to the thymic area or in the superior mediastinum, but because of their slow insidious growth over many years they have increased beyond these bounds when first seen. Fat is semifluid at body temperature and therefore gravity influences its further growth downwards along the side of the mediastinum, moulding itself to the heart and diaphragm and so giving it its typical appearance at operation.

Treatment can be dealt with very briefly and consists of excision because of compression effects. In no case was there evidence of malignancy, but the possibility of this in a deep-seated lipoma must be kept in mind.

### SUMMARY

A case of lipothymoma is added to a review of the literature of these rare tumours, which are found at any age.

Their clinical features and radiological characteristics have been described.

By a comparison and study of the pathology of these benign neoplasms with the normal histology of thymic involution, tumours showing remnants of thymic tissue, occurring usually in adults, are included under the term lipothymoma. This term is therefore not reserved purely for tumours showing an admixture of thymic and fatty tissue.

Their close relationship to mediastinal lipomas and the possibility that some of these may well contain thymic remnants is discussed.

### ACKNOWLEDGMENTS

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## PAPER ELECTROPHORESIS OF SERUM PROTEINS IN TEN CASES OF DISSEMINATED CANCER

BY

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PAPER electrophoresis is a relatively simple method of studying the proportions of the protein fractions in serum or plasma and does not demand the elaborate equipment required for the classical method of Tiselius. Many military laboratories have already acquired or made the necessary apparatus for paper electrophoresis and are using it to study the changes in serum proteins in various diseases. This paper deals with the alterations found in 10 cases of disseminated cancer admitted to Queen Alexandra's Military Hospital, Millbank.

Winzler (1953) has reviewed the extensive literature on all aspects of plasma proteins in cancer and his survey includes a section on electrophoresis, most of which deals with observations made with the classical Tiselius apparatus. Of the papers mentioned, that of Mider, Alling & Morton (1950) contains the most detailed information. The only findings based on paper electrophoresis mentioned by Winzler (1953) are those of Awapara *et al.* (unpublished) who used this method to determine the relative amounts of the serum proteins in normal individuals and cancer patients. Kay (1954) used paper electrophoresis (Flynn & de Mayo, 1951) to study the serum proteins in a series of patients with ascites caused by various conditions including carcinoma.

### METHODS

The methods used were those to be described by Hughes & French (in preparation). Total protein was estimated by the method of Kingsley (Hawk, Oser & Summerson, 1947). Paper electrophoresis was carried out in an Eel horizontal tank, bromo-phenol-blue was used as the dye and the resulting strips plotted by means of an Eel scanner built on the principles of the instrument described by Griffiths (1952). The value of each fraction was calculated from the resulting electrophoretic pattern.

A series of sera from 79 individuals has been examined (Hughes & French) by the same method and the mean values and ranges obtained are given for comparison (Table 1).

The diagnosis was established by biopsy or autopsy in nine cases and was evident at laparotomy in the tenth (Case 6).

Table 1

No.	Sex Age	Diagnosis	Total Pro- tein	Albu- min	Globulins				Remarks
					$\alpha_1$	$\alpha_2$	$\beta$	$\gamma$	
1	M. 57	Carcinoma ; Colon with metastases	5.8	2.2	0.6	1.6	0.6	0.8	P.M. Liver extensively involved. No ascites.
2	M. 21	Carcinoma ; Bronchus with metastases	7.3	3.5	0.2	1.1	1.4	1.3	P.M. Liver not in- volved. No ascites.
3	F. 44	Carcinoma ; Breast with metastases	6.6	2.9	0.2	0.7	0.7	1.1	P.M. Liver extensively involved. Ascites (clear fluid).
4	M. 49	Carcinoma ; Bronchus with metastases	5.75	1.4	0.5	1.1	0.85	1.0	P.M. Liver not in- volved but fatty de- generation present. No ascites.
5	F. 38	Carcinoma ; Ovary with ascites	6.0	2.6	0.4	1.0	0.9	1.1	Also developed pleural effusion.
6	M. 33	Carcinomatosis peri- toneal	6.1	2.7	0.5	1.2	1.1	0.6	Ascites present.
7	M. 23	Secondary carcinoma ; Spine	5.8	2.6	0.4	0.9	0.9	1.0	Primary not located. Liver not enlarged clinically.
8	F. 30	Malignant melanoma with metastases	7.0	2.9	0.6	1.5	0.8	1.2	Liver not enlarged clinically. Secondaries in lung.
9	M. 33	Carcinoma ; Oesopha- gus with metastases	6.2	3.4	0.4	1.0	0.7	0.7	Liver found involved at operation. No ascites.
10	M. 41	Seminoma with metastases	7.7	3.4	0.5	1.8	0.8	1.2	Liver not enlarged clinically. Abdominal glands involved.
Mean of 10 cancer cases			6.42	2.76	0.43	1.2	0.87	1.1	} Hughes and French
Mean of 79 normal sera			7.1	4.63	0.1	0.55	0.75	1.05	
Range of 79 normal sera			6.4-	3.8-	0.0-	.1-	.3-	.4-	
			7.8	5.7	0.4	.9	1.2	1.7	

Serum proteins expressed as g/100 ml.

## RESULTS

The results, together with brief clinical details, are given in Table 1 and an example of the type of electrophoretic pattern obtained on scanning is shown in Figure 1.

It will be seen from Table 1 that in the 10 cases of disseminated cancer examined there was, when compared with the range of normal sera, a decrease in the total protein (6 cases), a decrease in the albumin (10 cases), an increase in  $\alpha_1$  globulin (5 cases), an increase in  $\alpha_2$  globulin (8 cases), but little alteration in the  $\beta$  and  $\gamma$  globulins.

It is obvious from Table 1 that these changes occur in disseminated cancer irrespective of the primary site and of the presence of metastases in the liver.

## DISCUSSION

Our results are in general agreement with those published by Mider *et al.* (1950), Awapara *et al.* (quoted by Winzler, 1953) and Kay (1954). We have not



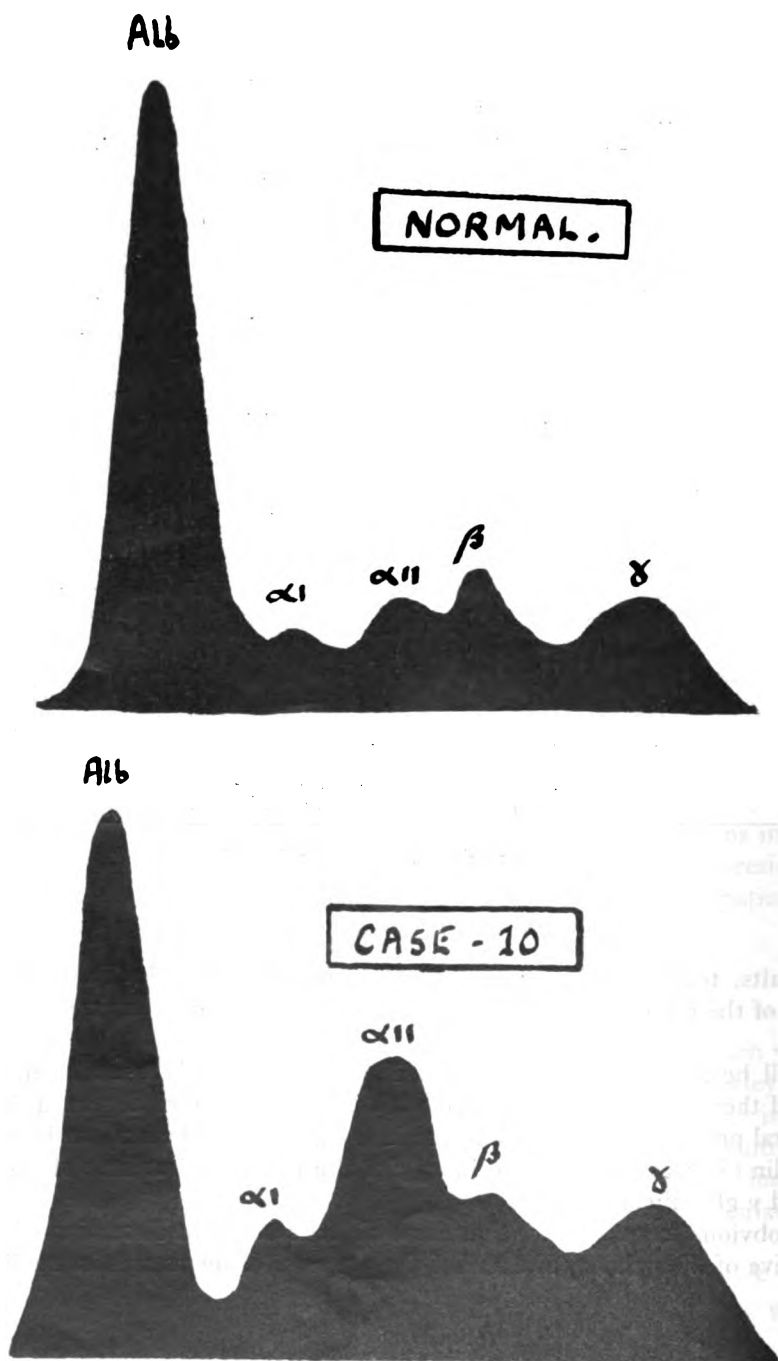


FIG. 1. . Electrophoretic pattern.

attempted to make a direct quantitative comparison with the figures given by these authors as there are so many variable technical factors which may influence the results in different laboratories (Martin & Franglen, 1954).

Winzler (1953) in his review concludes that significant abnormalities are associated with cancer, but that they are not specific. For example, increases in alpha globulins are frequently met with in inflammatory conditions and in diseases involving tissue destruction. Nevertheless in certain circumstances a study of the serum proteins may be of diagnostic value. Kay (1954) found electrophoresis of serum protein in ascites revealed distinct and constant patterns in cirrhosis of the liver and carcinomatosis peritonei. If the ascites was due to cirrhosis there was an increase mainly in the  $\gamma$  globulins, whereas if the condition was due to carcinoma the increase was mainly in the  $\alpha_2$  globulin.

The explanation and significance of the changes in serum proteins in cancer is at present largely unknown.

### CONCLUSION

1. Sera from 10 cases of disseminated cancer have been examined by paper electrophoresis.
2. The principal alterations found were a decrease in the albumin fraction and an increase in the  $\alpha$  globulin.

### ACKNOWLEDGMENTS

We would like to record our appreciation of the assistance received from the medical staff of the Q.A. Military Hospital and from Captain P. D. Meers, R.A.M.C., who performed the autopsy on Case 3.

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## SKI-ING INJURIES

BY

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THE rapid increase in ski-ing injuries in recent years has given rise to much concern, and a pilot investigation was carried out among British troops in Austria during the 1954 season, with a view to a more complete investigation in 1955. Unfortunately, in 1955 extremely bad snow conditions prevailed, and facilities for ski-ing were much restricted, so the two seasons were not comparable; however, certain tentative conclusions may be drawn from this investigation, although the data are not as valuable as had been hoped.

Seventy-eight injuries occurred during the 1955 season, but accurate figures of the numbers at risk were not available.

### *Types of Injury*

Sprain of ankle with strain of medial collateral ligament of the knee	21 (27%)
Strain of medial collateral ligament alone	18 (23%)
Sprain of ankle	11 (14%)
Fracture of lateral malleolus of ankle	11 (14%)
Complete rupture of medial collateral ligament	2 (3%)
Sprain of forefoot and/or fractured metatarsals	5 (7%)
Fracture of tibia and fibula	1 (1%)
Fractured metacarpals	3 (4%)
Fractured elbow	1 (1%)
Dislocated shoulder	1 (1%)
Fractured skull	1 (1%)
Soft tissue injuries	3 (3%)

Excluding the last five types (9 cases) the violence causing injury is a forced medial rotation of the leg, or a forced abduction of the knee or a combination of these two forces. The commonest occurs in a fall forwards and laterally, the ski catching with the tip or outer edge and forcibly rotating the leg inwards. The second occurs in traversing or turning when the upper (or inner ski in a turn) ski is weighted, the legs diverge and the inner edge of the ski catches in the snow.

No cases of torn meniscus were diagnosed, but five of seventy similar injuries of the knee, all presenting as strain of the medial collateral ligament when first seen, in the 1954 season subsequently presented signs of meniscus damage and were operated upon, four of them ski-ing uneventfully during the present season. It is considered likely that a number of the above cases of strain of the medial ligament have also sustained damage to the meniscus but none presented with unequivocal signs.

Contributory factors which in the 1954 series were suggested, were investigated.

1. *Experience*

Less than one hour on ski	...	...	...	...	5 ( 8%)
Less than one day on ski	...	...	...	...	8 (11%)
Less than two days on ski	...	...	...	...	7 ( 9%)
Less than one week on ski	...	...	...	...	19 (26%)
Less than one month on ski	...	...	...	...	17 (23%)
One season of ski-ing	...	...	...	...	8 (11%)
Two seasons of ski-ing	...	...	...	...	6 ( 8%)
Three or more seasons	...	...	...	...	3 ( 4%)

2. *Instruction*

37 injuries (46%) occurred whilst the patient was under instruction.

3. *Weather*

Sunny	...	...	...	...	...	39 (50%)
Cloudy	...	...	...	...	...	37 (47%)
Snowing	...	...	...	...	...	2 ( 3%)

4. *Type of Snow*

Powder	...	...	...	...	...	30 (38%)
Icy	...	...	...	...	...	32 (40%)
Breakable crust	...	...	...	...	...	2 ( 3%)
Wet Snow	...	...	...	...	...	14 (19%)

5. *Types of Bindings*

Kandahar	...	...	...	...	...	66 (96%)
"French" or Langfrieman	...	...	...	...	...	1 ( 1%)
Greenland or B.S.C.	...	...	...	...	...	8 (10%)
Suwe Marker	...	...	...	...	...	2 ( 2%)
Tyrolea	...	...	...	...	...	1 ( 1%)
Skifree	...	...	...	...	...	0 ( 0%)

Unfortunately efforts to obtain controls for the above figures were unsuccessful for a variety of reasons, but the following observations are considered pertinent. There is a high proportion of injuries in the first week (54 per cent.) but, surprisingly, the proportion occurring among those not under instruction was not as high as the pilot experiment had led us to expect. However, the absence of snow on the lowlands, where the bulk of unorganized ski-ing usually takes place, may explain this, as the effect would be to increase the relative amount of ski-ing done in organized classes. Much more ski-ing was done in fine spells so the fact that half the injuries occurred during bad weather possibly supports the contention that bad visibility, by preventing the skier from seeing irregularities and bumps, increases the risk of accident. Breakable crust failed to live up to its reputation as a bone-breaker, and no conclusions are drawn as to the relative safety of different types of snow.

The pilot investigation incriminated the Kandahar binding as the probable

factor, and this year safety bindings were made available to all skiers. Safety bindings were manufactured for all skis issued to troops and their use was encouraged, but, unfortunately, efforts to discover the proportion using them were unsuccessful.

It should be explained for the benefit of non-skiers that the Kandahar binding consists of a wire cable passing round the heel of the boot to two hooks on the side of the ski, level with the instep, and thence to a cable tensioner in front of the toe or by clips on to the sole of the boot. In this binding the heel can be raised about one inch, and both heel and toe are affixed to the ski.

The Langfrieman has similar toe irons, but the heel is firmly attached to the ski by a long leather thong wound round the ankle and passing through D rings on the side of the ski. This binding is only used by experts, and injury is certain in a bad fall unless the ski breaks first.

The Greenland (named after H. Greenland, Esq., the inventor) or British Ski Club safety device is used in conjunction with a normal Kandahar and consists of a leather strap around the heel cable behind the heel, and the strap passes through a D ring on the upper surface of the ski about four inches behind the heel. The strap is adjusted so that it is completely taut in the "Vorlage" (forward lean) position, so that if a forward fall occurs the strap will pull the heel cable off and release the binding. The device needs careful adjustment, as if it is too tight the ski will come off in normal running (this led many to discard the device without giving it a fair trial), whilst if it is too loose it fails to release the foot. This is what occurred in all eight cases of accidents with this binding and their ski failed to come off.

This binding was issued to all holders of Army skis as it is cheap to produce and is used with the normal binding.

The other types of safety bindings in use operated on a different principle; although differing in detail, their mode of action was similar.

They replace the toe clips of a normal binding, the cable and tensioner being unaltered. They consist of a portion fixed to the ski in front of the boot, on which is mounted a rotating portion, which is retained in the normal fore and aft position by a spring-loaded ball engaging in a slot on the fixed portion.

In the Suwe Marker (German) the upper portion engages the toe of the boot above the welt, in the Tyrolea (Austrian) two L-shaped pieces are pivoted on the moving portion with the long arms facing backwards, and the toe is introduced between the long arms with the toe pressing on the short arms and thus clamping the boot; in the Skifree (Swiss) a rigid metal plate is attached to the boot and the ridge engages in a groove on the rotating portion of the binding; at the top of the groove is a small wheel, so this type has the added advantage of releasing in a backward fall. Whenever a rotational strain sufficient to overcome the ball spring tension is applied, the upper portion of the binding rotates on the lower part and the toe is released. Again the device must be correctly tensioned, and if too loose it will release in a turn (this accounted for one of the Suwe cases), whilst if too tight injury occurs without it releasing, as happened in the remaining two cases. The Tyrolea bindings were fitted to twenty pairs

of Welfare skis and no accident occurred in users of these, and observations at the B.T.A. sports meeting indicated that approximately 50 per cent. of those with their own skis were using one or other of these devices, which cost approximately 25s.

### CONCLUSION

The figures tend to support the opinion that the commonest type of injury in ski-ing is caused by a forcible rotation of the leg which is attached to the ski. The only factor among those investigated that can clearly be incriminated is the rigid binding, and it is noteworthy that before the war, when the Alpina or Arlberg binding, which allowed the skier to lift his heel clear of the ski, was in vogue, many less injuries were seen. The correct use of safety bindings will remove this hazard, but none of the devices is foolproof and all require careful adjustment. Further development of these devices should remove these faults and lead to an appreciable reduction of ski-ing accidents.

### SUMMARY

A series of seventy-eight ski-ing accidents is analysed, showing the types of injury and recording various possible contributory factors. It is believed that this paper represents the first attempt to study the effect of safety bindings in the prevention of accidents.

I should like to express my thanks to Major M. M. Lewis, M.B.E., R.A.M.C., D.A.D.A.H., British Troops in Austria, for his assistance in his collection of figures.

# HEAD INJURIES TO MOTOR-CYCLISTS

BY

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AND

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MUCH of the research on the usefulness of crash helmets has been peculiarly concerned with army experience, since the pioneering work of Sir Hugh Cairns (1) at a military hospital in 1941, about the time when the compulsory use of crash helmets was being introduced into the army. This first paper was a discussion of seven case histories, and in due course, by 1943, in association with Holbourn (2), he had amassed data on 106 accidents to wearers of helmets. These were cases admitted to the Military Hospital for Head Injuries near Oxford, and were therefore a selection from all accidents, but the authors showed that a marked difference existed between these cases and another group who were not wearing helmets, and concluded that the helmet was of great protective value.

In an address to the Royal Society of Medicine in 1946, Cairns (3), reviewing the work, appealed to the Army Medical Services in peace time to carry out investigations, since they were in a unique position to make further contributions. This is indeed true in a sense, since the wearing of helmets has remained compulsory for soldiers riding motor-cycles on duty ever since, while among civilians it is still a novelty. It would appear to be of interest, therefore, to compare accidents in the two groups, and also between the army motor-cyclists and other army road-users. Some work by the Army Operational Research Group (4) soon after the last war produced an estimate of the proportion of head injuries among motor-cyclists from a series of Claims Commission files, and there have been tentative comparisons with civilians in reviews made by the Road Research Laboratory (5), but although the indications have been in favour of the wearing of crash helmets, the evidence itself appeared to be slender owing to the doubtful comparability of the sets of data.

The opportunity now exists to examine more up-to-date figures from the records of hospital admissions which were the result of transport accidents, the term "admission" being defined as a stay of over forty-eight hours; the coverage is theoretically complete for every soldier involved in an accident, whether admitted to a military hospital or other medical unit, or to a civilian hospital. At the same time, a General Register Office survey (6) has become available covering civilian road-users who were admitted to hospital, and happily one of the bugbears of comparison has been removed by the common use of the International Statistical Classification (7); but there are plenty of other causes for doubt, as will appear. For one thing, the civilian sample may not be com-

pletely representative because it was collected, in great part, from teaching hospitals in large towns ; for another, there is no "home nursing" for soldiers, and it may be supposed that they are admitted to hospital in cases of lesser severity rather more often than civilians. For this reason, the category "superficial injuries" (International Code N910-N929) is omitted from the comparisons in Table 1, although this only goes part of the way to solving the problem. There is the possibility, for example, that superficial head injuries (included in N850) are more readily admitted to a military hospital ; however, in a comparison with civilians, this would weight the evidence against helmets, and cannot be said to weaken the argument in their favour ; as between groups of army road-users the same standards apply to all.

The civilian figures relate to 1949, while the army figures relate to admissions for the whole of 1952, to medical units in the United Kingdom. Only males were counted in each group.

Table 1. *Head injuries\* expressed as percentages of all injuries†*

	Pedestrians	Pedal cyclists	Motor-cyclists	Other Vehicles
Army ... ..	48.8	32.4	30.8	38.2
Civilian ... ..	48.3	50.5	46.7	42.3
Difference ... ..	0.5	18.1	15.9	4.1
Standard of error of difference	8.2	6.9	4.4	4.4
<i>Actual numbers of injuries</i>				
Army { Head ... ..	21	22	127	125
All ... ..	43	68	412	327
Civilian { Head ... ..	130	111	79	82
All ... ..	269	220	169	194

\* International Code N800-N804, N850-N856.

† Except International Code N910-N929.

The most significant difference is where one would hope to find it, between army and civilian motor-cyclists, and in further support of the case for helmets, the former have an advantage of  $7.4 \pm 3.5$  per cent. over the drivers of other army vehicles. Incidentally, the nearest thing we have to a control is the similarity of other vehicle accidents among civilians, and this might be held to satisfy the point made above about different standards of hospital admissions, in so far as this affects the site of injury.

Having stated the results that suit our book, we must not fail to observe what other conclusions can be drawn from the figures ; for example, army pedal cyclists (on a much smaller sample) seem to have an advantage over civilians—and they do not wear helmets yet. (This particular comparison is more easily attacked on the grounds of the differing age distribution, since child cyclists are included, whereas they are automatically ineligible for the motor-cycle comparison.) It is notable that in spite of crash helmets, a large number of head injuries continue to occur, so that their presence does not have a sort of talisman effect. Cairns (1) set a proper bound to the problem in his first paper



when he said: "The most effective method of preventing head injuries in motor-cyclists is careful driving. In addition the use of a crash helmet is advocated." There is no direct evidence in the tables that the actual number of injuries is reduced, only that the distribution is altered; a badly designed and fitted helmet could easily lead to greater risk of an accident.

Another point to notice in the tables is the high incidence of head injuries among car drivers, and indeed all accidents connected with transport have this feature as compared with other types of accident; in the army, the average over all accidents is about 13 per cent. of injuries to the head: there is a greater difference here than between the various groups of road-users. In a "Discussion on Head Injuries in Civilian Practice" at the Royal Society of Medicine, Section of Surgery, Walpole Lewin (8) of the Radcliffe Infirmary, Oxford, drew attention to the risk of car occupants sustaining head injuries by hitting some projection, and raised the question of redesigning for car manufacturers. Discussing crash helmets for motor-cyclists in the same contribution, he spoke as follows of recent experience at the Military Hospital for Head Injuries, Oxford: "Of the last 20 motor-cyclists admitted with head injuries, 17 sustained their accidents off duty, usually at the week-ends, and when they were not wearing crash helmets." It is interesting to consider how that statement, from a hospital which specializes in head injuries, is related to Table 2, which covers all injuries throughout the country in a single year.

In this table the same army data as for Table 1 are partitioned according to whether the injuries were or were not stated to have been sustained on duty (including training). It may be seen that the percentage of injuries to the head was significantly lower for those stated to have been on duty, not only for the motor-cyclists, but also for the occupants of other vehicles.

Table 2. *Head injuries expressed as percentages of all injuries*

<i>Army motor-cyclists</i>				
On duty	...	...	...	24.1 per cent. (32 out of 133)
Off duty or unspecified	...	...	...	34.1 per cent. (95 out of 279)
Difference	...	...	...	$10.0 \pm 4.9$ per cent.
<i>Other army motor vehicles</i>				
On duty	...	...	...	33.5 per cent. (75 out of 224)
Off duty or unspecified	...	...	...	48.5 per cent. (50 out of 103)
Difference	...	...	...	$15.0 \pm 5.7$ per cent.

It is likely that many of the unspecified cases were in fact on duty, and their presence with the off-duty cases would presumably tend to keep the percentage lower.

On the evidence of the motor-cyclists alone, it might seem fair to conclude that crash helmets were not so often worn off duty (as suggested by the observation of Walpole Lewin), and that this caused the higher rate of head injury. But the same feature in occupants of other vehicles indicates that different factors may also be at work. For instance, off-duty accidents may be more severe, and this circumstance could be reflected in a higher percentage of head injuries.

The week-end spare time army motor-cyclist is engaged in a pursuit which has perhaps more affinity with civilian motor-cycling, and the wearing of a helmet is only the most distinctive sign of the on-duty motor-cyclist. The latter is probably a more proficient rider, and his machine is better maintained. (We should observe that off-duty drivers are likely to contain a considerable proportion of men who never drive as a duty and may be relatively unskilled.)

Undoubtedly, there will be further weaknesses in the argument from clinical data, although they are undeniably consistent with the hypothesis that helmets afford protection. Our purpose has been to show that, when fuller civilian figures can be obtained, there exists a reasonable control in army experience.

### SUMMARY

Figures of injuries resulting from transport accidents have been obtained from army medical records, and compared with such civilian figures as are available, and also examined for internal evidence of a difference between motor-cyclists and other road-users. The percentage of injuries which affected the head was lower for army motor-cyclists than for civilians, and, within the army, lower for on-duty motor-cyclists than for those off duty. These differences could be accounted for by the fact that on-duty motor-cyclists would wear crash helmets whereas those off duty might not, and civilians (in 1949) very largely would not. But soldier occupants of motor vehicles other than motor-cycles are less prone to head injuries when they are on duty than when they are off, and it seems that factors other than the wearing of crash helmets might be operating, such as proficiency in driving and the maintenance of the vehicle. Although it might appear that these could only reduce the total number of accidents, it is possible that the distribution of accidents could also change when they are of lesser severity: for example, in non-transport accidents the percentage of head injuries is much lower.

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## NON-SPECIFIC URETHRITIS\*

A PROBLEM OF MANAGEMENT RATHER THAN OF REPEATED ANTIBIOTICS

BY

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### INTRODUCTION

NON-SPECIFIC urethritis is a disease of uncertain ætiology, which is difficult to treat and often relapses. As many antibiotics have been used in its treatment as pathogens have been blamed for its causation. Our experience in this Centre leads us to believe that a further reduction in the relapse rate can be achieved by skilful man-management.

### METHOD

The relapse rate and its causation have been studied in 378 fresh cases of non-specific urethritis. None of these cases had had treatment for the condition prior to attending this Centre.

The diagnosis was established by finding, within seven to twenty-one days of exposure, a hazy urine with numerous pus threads and a mucopurulent discharge which on staining by Gram's method showed numerous pus cells, occasional epithelial cells and organisms other than gonococci—*e.g.* diphtheroids, straphylococci, streptococci, coliforms and mouth commensals.

Non-specific urethritis was differentiated from traumatic urethritis produced by excessive sexual activity or "milking down" of the urethra, and from chemical urethritis produced by the intra-urethral use of strong antiseptics. These conditions cause a sparse discharge in which epithelial cells greatly outnumber pus cells. All cases were treated as follows :

- (a) Streptomycin 1 gram *stat.*
- (b) Sulphadiazine 2 grams *stat.*, followed by 1 gram every four hours to a total of 32 grams.
- (c) *Mist. sod. cit.*  $\frac{1}{2}$  fl. oz. *q.d.s.* and fluids to 7 pints daily throughout the course of treatment.

In addition it was strongly stressed to the patient that he should abstain for

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\* Written in January, 1955.

six weeks from all forms of alcohol, coca-cola, coffee (the latter two contain caffeine), further sexual exposure and all manual interference.

Routine surveillance was a clinical check of urine and discharge (if present) at seven and fourteen days. Final test of cure at three months was a clinical examination of urine, discharge (if present) and prostate.

Serological tests for syphilis were negative in all cases.

Table 1. *Results of treatment*

Fresh Cases				After Gonorrhœa			Combined Relapse Rate
Follow-up	Followed	Relapsed	Relapse	Followed	Relapsed	Relapse	
1-7 days	329	27	8.2%	49	2	4.1%	7.7%
8-14 days	329	25	7.6%	49	6	12.2%	8.2%
15-28 days	329	8	2.4%	49	—	—	2.1%
28 days to 3 months	329	2	0.6%	49	—	0	0.5%

In 378 cases, 70 relapses. Total Relapse Rate 18.5%.

Table 2. *Details of relapses*

Fresh Cases					After Gonorrhœa			
Follow-up	Alcohol	Manual trauma	Fresh exposure	Unknown	Alcohol	Manual trauma	Fresh exposure	Unknown
1-7 days	2	5	1	19	1	0	0	1
8-14 days	12*	6	2	5	4	1	0	1
15-28 days	3	1	0	4	—	—	—	—
28 days to 3 months	0	0	0	2	—	—	—	—
Total Relapses due to	17	12	3	30	5	1	0	2

\* Two cases classified under alcohol were actually anæsthetic relapses. Both cases had ether.

Table 3. *Relapses due to unknown causes (i.e., true treatment failure) compared with known causes*

Fresh Cases (329)				After Gonorrhœa (49)				Combined (378)			
Follow-up		Known		Unknown		Known		Unknown		Known	
		No.	%	No.	%	No.	%	No.	%	No.	%
At 3 months		32	9.7	30	9.1	6	12.2	2	4.1	38	10.1
										32	8.5

## RESULTS

Table 1 shows that of 378 cases treated during the period, 70 relapsed, giving a relapse rate of 18.5 per cent., and that there was no significant difference in the relapse rate between fresh cases and cases occurring after gonorrhœa.

Table 2 shows that of the 70 cases which relapsed, 22 were due to indulgence in alcohol, 13 to manual trauma, 3 to fresh exposure, and 32 to unknown causes.

Table 3 shows that the true relapse rate due to failure of treatment was 8.5 per cent.

To determine the effect of other antibiotics on the relapse rate a further 75 cases of previously untreated non-specific urethritis were divided into three groups of 25 cases each.

The first group was treated with the routine method of 1 gram streptomycin and 32 grams sulphadiazine, and had a relapse rate of 19 per cent.

The second group was treated with a course of terramycin, 500 mg. *stat.* and 250 mg. every six hours to a total of 5.5 g. This group had a relapse rate of 36 per cent.

The third group was treated with a course of aureomycin 500 mg. *stat.* and 250 mg. every four hours to a total of 8.5 g. This group had a relapse rate of 25 per cent.

The number of cases in this trial was small. Nevertheless the trial indicates that the tetracycline group of antibiotics hold no dramatic therapeutic advantages over the current method of treatment using streptomycin and sulphadiazine.

### *Mechanism of Relapse*

The one common factor in the relapses due to known causes is excessive production of mucus by the glands surrounding the urethra. This can be caused by alcohol, anæsthetic gases (especially ether), trauma (either manual interference or sexual intercourse) and caffeine. No adequate explanation has been discovered for the relapses not due to the agents listed above, and it must be surmised that they are due to failure of the treatment given.

### *Treatment of Relapses*

Treatment of the first relapse was a course of streptomycin 1 gram daily for six days and *mist. sod. cit.*  $\frac{1}{2}$  fl. oz. *q.d.s.* for seven days. Treatment of the second relapse was a course of aureomycin 500 mg. *stat.* and 250 mg. four-hourly to a total of 8 g. Fluids during this course were restricted to 3 pints per day.

Of the 22 relapses due to alcohol, 17 responded to streptomycin and 3 responded to streptomycin followed by aureomycin. The remaining 2 had developed prostatitis despite courses of streptomycin and aureomycin, and finally responded to irrigations of potassium permanganate, 1/10,000.

Of the 13 traumatic relapses, 10 responded to streptomycin and the other 3 to a course of streptomycin followed by aureomycin. All the relapses due to fresh exposure responded to a further course of streptomycin.

Of the 32 relapses due to unknown causes, 8 responded to streptomycin and 14 responded to streptomycin followed by aureomycin. The remaining 10 developed prostatitis; 8 responded to irrigations (after courses of streptomycin and aureomycin) and 2 responded to intravenous T.A.B. therapy after courses of streptomycin, aureomycin and irrigations.

The 70 relapses were followed for a further three months and were all

clear at that time, when prostatic examination revealed normal prostates in every case.

It should be noted that the relapses due to known causes responded much more readily to treatment and developed fewer complications.

An interesting case which illustrates our point for the necessity of management is the following. A warrant officer who contracted non-specific urethritis was treated at a clinic outside our jurisdiction. Over a period of six weeks he received sulphadiazine (32 g.), streptomycin 8 g., penicillin 1 mega unit, chloromycetin 7.5 g., aureomycin 8 g. and terramycin 6.5 g. His discharge persisted in spite of the sustained antibiotic medication, and when he attended this Centre he presented with a typical non-specific urethritis. On questioning it became obvious he had received inadequate instruction on the conduct necessary whilst undergoing treatment and surveillance. He had not only made a habit of "milking down" his urethra twice daily to ascertain if his discharge persisted, but also had been consuming alcohol at regular intervals during his treatment. The position was explained to him and he was given a course of streptomycin 1 gm. daily for six days, sulphadiazine 1 g. four-hourly to a total of 32 g., *mist. sod. cit.*,  $\frac{1}{2}$  fl. oz. *q.d.s.*, and fluids to 7 pints. He was clinically clear for the first time at seven days and remained so until his final test of cure.

### CONCLUSIONS

We consider that the treatment for non-specific urethritis is much more than merely the administration of antibiotics. Very little has been said in the existing publications about the necessity for the patient's co-operation whilst undergoing the appropriate drug therapy. We believe that drug therapy alone is never sufficient; this is brought out when the low relapse rate (8.5 per cent.) due to unknown causes is considered.

The clinical trial involving 75 cases revealed that streptomycin and sulphadiazine are the most effective therapeutic agents in the treatment of this condition, bearing in mind that the co-operation of the patient is essential, and that aureomycin appears more efficacious after a course of streptomycin and sulphadiazine. Aureomycin given from the onset appears to give slightly better results than terramycin.

### SUMMARY

Some 378 previously untreated cases of non-specific urethritis were treated with streptomycin and sulphadiazine. The total relapse rate after three months was 18.5 per cent., but if relapses due to known and avoidable causes were subtracted the relapse rate was 8.4 per cent.

The importance of avoiding known causes of relapse by management of the patient is emphasized.

The mechanism of relapse and treatment of relapse are discussed, and an

illustration of a mismanaged case given. The incidence of complications related to the cause of the relapse is noted.

From a small clinical trial involving a further 75 fresh cases of non-specific urethritis it was found that treatment using streptomycin combined with sulphadiazine gave the best results, and that aureomycin gave slightly better results than terramycin.

#### ACKNOWLEDGMENTS

We are indebted to Colonel J. W. A. McIver, R.A.M.C., Commanding Officer of this hospital, and to Lieut.-Colonel R. M. Johnstone, M.B.E., M.C., R.A.M.C., Medical Specialist, for constructive criticism and encouragement.

## **“THE FLOWING STREAM”**

**EASTERN COMMAND MEDICAL EXERCISE, 1955**

BY

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IN the event of another major emergency many of the more junior Regular and Territorial officers would find themselves either employed as regimental medical officers or posted to field ambulances.

Major-General A. Sachs, C.B., C.B.E., Q.H.P., the D.D.M.S., Eastern Command, decided that his 1955 exercise would be planned to meet the requirements of these officers and consequently it was mainly confined to a study of the medical services in the forward areas. Included in the programme was a session devoted to clinical problems and this innovation proved to be an unqualified success.

The exercise began with a review of the organization and role of the various medical units in the forward area. Lieut.-Colonel J. D. Finnegan spoke about the infantry division field ambulance; Lieut.-Colonel H. J. L'Etang, the armoured division field ambulance; Major R. B. Robinson, the airborne field ambulance; Major W. F. de C. Veale, the field dressing station; and Lieut.-Colonel J. L. D. Roberts, the casualty clearing station. This was followed by descriptions of how a field ambulance might function in the field. Lieut.-Colonel G. N. Prideaux, G.S.O.1 (Trg.), Eastern Command, depicted with the aid of a large floor model the situation in which we were attacked while holding a position along a river. Lieut.-Colonel M. W. Gonin, D.S.O., described how he would deploy an infantry division field ambulance in defence; Lieut.-Colonel D. T. Rowlands spoke on the parachute field ambulance in defence; and Colonel J. A. Dudgeon, M.C., told how he would use the field ambulances of an armoured division in the counter-attack. For the second situation, which dealt with an attack, Colonel S. G. de Clive Lowe gave his dispositions for the medical units of an infantry division, and finally Colonel G. Rigby-Jones discussed the deployment of the medical services of an airborne division after an air drop.

The following morning was devoted to the treatment of casualties in the forward area. A number of excellent “mock” casualties provided by the 6th Field Ambulance were demonstrated as they were admitted to an R.A.P. Each type of casualty was discussed informally by an experienced specialist, the emphasis throughout being on the first aid treatment in the battle area. In addition, Sir Arthur Porritt, K.C.M.G., C.B.E., Professor G. A. H. Buttle, O.B.E., Mr. R. J. Furlong, Brigadier J. Huston, Q.H.S., and Lieut.-Colonel W. H. Scriven, M.B.E., formed an expert panel who commented on various points raised by each speaker.



*Case No. 1—G.S.W. of jaw (Fig. 1, Plate I)*

Brigadier Huston and Lieut.-Colonel D. V. Taylor, R.A.D.C., stressed the importance of maintaining a free airway and reminded us that a good way to achieve this was to pass a suture through the tongue. The patient should be nursed in the prone position.

*Case No. 2—G.S.W. of chest and upper abdomen*

Colonel G. B. Parker, D.S.O., T.D., who had much experience with the Maquis of surgery under far from ideal conditions, pointed out that this type of wound, if on the right side, involved the liver and the prognosis depended to some degree on the extent of the damage; if on the left side, it always damaged a hollow viscus and the outlook was grave. Such a case should not be moved.

*Case No. 3—G.S.W. of chest (sucking)*

Colonel Parker stressed that the first and most important thing was to cover the wound, and he recommended *tulle gras*. Tension pneumothorax, if it developed, could be relieved by inserting a needle. He considered that the evacuation of this type of casualty was not contraindicated. Sir Arthur Porritt confirmed that treated sucking wounds of the chest travelled quite well by air at low altitude.

*Case No. 4—G.S.W. of pelvis*

This casualty had been wounded twelve hours previously. Colonel Parker considered that if this man had been brought in earlier, then blood transfusion and operation might easily have saved his life, but he felt that the prognosis was poor if first seen twelve hours after wounding. In the A.D.S. such a case should have a dressing applied and possibly a catheter inserted into the bladder. This casualty could be evacuated by air.

*Case No. 5—Blast injury of chest*

Colonel N. C. Oswald, T.D., recommended penicillin to minimize broncho-pneumonia, morphine if necessary and the administration of oxygen if available. He considered that there was no place for atropine in the treatment of such casualties. If a hæmothorax developed, then this might require aspiration. Evacuation by jeep might make the patient worse, but he could be moved by air at low altitude if the journey was not long.

*Case No. 6—Compound fracture of femur*

A Thomas splint had already been applied. Colonel C. M. Marsden, Q.H.S., drew our attention to the shocked condition of the patient who had a small entrance wound and a large bleeding exit wound in the thigh. In the R.A.P. bleeding must be stopped by pressure dressing, artery forceps, or if necessary by a tourniquet properly applied. If a tourniquet was used, then a large "T" should be marked on the patient's forehead and an entry made on his field medical card. This type of casualty required evacuation to a surgeon without



FIG. 1



FIG. 2

PLATE I



more delay than was necessary to check his condition at the A.D.S. On reaching the surgical centre he was treated as a Priority I case and, after resuscitation, taken to the operating theatre. Amputation was necessary if the tourniquet had been on over two hours. Blood must be available if these cases were not to die.

*Case No. 7—Mine wounds (multiple)*

This patient had been injured by a mine and had sustained multiple injuries with extensive muscle damage and fractured tibia, humerus and hand. The treatment of these wounds consisted of stopping the hæmorrhage, relieving pain, immobilizing the fracture and evacuating the casualty as quickly as possible. His general condition soon after wounding was fair, but quickly deteriorated and by the time of arrival at the casualty clearing station he was severely shocked. Blood was required in considerable quantity. Surgery consisted of extensive excision of devitalized muscle tissue and possibly amputation if a limb was severely damaged.

*Cases Nos. 8 and 9—Burns (Fig. 2, Plate I)*

No representative collection of modern war casualties would be complete without an example of burns, and our last two patients illustrated this major problem. Lieut.-Colonel R. A. Stephen, O.B.E., gave a very clear and concise account of modern views on the treatment of burns. The "rule of 9" provided a fairly accurate means of assessing the extent of a burn and such an assessment was made as early as possible. At the R.A.P., burns were covered and the patient was not undressed. Burns of the face, however, were left exposed and the patient propped up to reduce swelling. With burns involving the hands it was necessary to remove rings, important to start finger movements early and best to keep the hands elevated. Œdema of the mucosa of the respiratory tract following the inhalation of hot fumes sometimes made tracheotomy necessary. While the patient was still at the R.A.P. oral fluids were given, a start made with the administration of antibiotics and one dose of tetanus toxoid injected if circumstances permitted. On arrival at the C.C.S. all but the minor burns required intravenous fluid, and the quantity of fluids needed was calculated from the extent of the burn and body weight. Lieut.-Colonel Stephen stressed that if for any reason casualties could not be evacuated, then it would be necessary to arrange for resuscitation to be carried out in the divisional area.

This completed the discussion on the treatment of specific casualties in the forward area. Professor Buttle then gave a short discourse on blood transfusion in the field and on the use of antibiotics. He stressed that blood transfusion was mainly of use when combined with surgery. For transfusion at the C.C.S. we would require Group O blood, as we could not hope to carry out blood grouping at this level. If a formation was isolated or if the lines of communication were very long it might be necessary to transfuse in the divisional area, but in these circumstances we should have to rely mainly on dextran or plasma, as there were technical difficulties which limited the supply of blood far forward. Travelling transfusions required very careful supervision and were not advised

except perhaps in quiet times. Setting up a transfusion in a collapsed wounded man under active service conditions was not always easy, but a good light, pressure on the arm and massage all helped to make entry into the vein possible. Blood transfusion might increase the absorption of previously injected morphine, and a number of cases of morphine poisoning following transfusion were seen in the last war. Turning to antibiotics, Professor Buttle thought that soluble penicillin was the agent of choice in severely wounded men. Procaine penicillin could be given in addition, but absorption was sometimes delayed in shocked individuals. The emergence of penicillin-resistant strains of organisms such as *Staphylococcus aureus* might present a problem particularly in burns units. Centres treating burns would probably require a battery of antibiotics. Two antibiotics could sometimes be used together but this procedure required laboratory control.

Lieut.-Colonel Scriven spoke about the problem of anæsthesia in the field. He pointed out that while the transport of the army was being drastically cut, anæsthetic apparatus was becoming more and more elaborate. He put forward a well-argued plea that we should not forget the simple method of anæsthesia which involved no more than a "rag and bottle" and which could be easily transported. The newer relaxants would prove of great value in the field. Much had been heard recently about artificial hibernation, but further experience was required before a decision could be reached on this procedure.

The purely clinical portion of the exercise was concluded after a discussion on the maximum permissible interval between wounding and surgical intervention. Brigadier Huston, Mr. Furlong, Sir Claude Frankau, Sir Arthur Porritt and Colonel Parker contributed to this discussion. All agreed that it was important to keep this interval to a minimum, but most speakers felt that the problem had been exaggerated and had tended to become a bogey. It was considered that when, for any reason, casualties could not be evacuated, then the solution was to send the surgeon and his team to the casualties and evacuate the surgeon after his job was done.

The G.O.C.-in-C., Eastern Command, Lieut.-General Sir Francis Festing, K.B.E., C.B., D.S.O., after thanking everyone for giving up their week-end to attend the exercise, spoke of the value of the medical services in maintaining the morale of an army. Referring to the problem of evacuation which we had been discussing, he observed that long lines of communication might well be impossible in a nuclear war and then medical care would be required on the spot.

After lunch we turned our attention to a somewhat different problem and studied the medical requirements of a division operating in a limited war, transported by air and supplied in the first instance by air only. The problems were primarily those of administration, army health and tropical medicine rather than surgery, as no fighting had taken place. The principal speakers in this serial were Colonel T. Woods, O.B.E., Colonel J. H. Anderson, Colonel R. Johnston and Colonel A. MacLennan, O.B.E. The important lessons which emerged from this study were the need for a very high standard of hygiene training and the necessity for maintaining 100 per cent. protection by inocu-

lation and vaccination in units employed in a "fire brigade" role. Colonel W. Moursund, M.C., U.S.A., who had served in the part of the world under discussion, pointed out that the airfields on which we had based all our planning were frequently rendered unserviceable in wet weather !

As a final problem we considered possible changes in the medical organization of the division. Colonels Dudgeon, Rigby-Jones and de Clive Lowe and Lieut.-Colonel S. O. Bramwell, M.B.E., gave their views on this subject, and Brigadier W. H. B. Bull, O.B.E., E.D., Q.H.S. (N.Z.R.A.M.C.), Brigadier H. L. Glyn Hughes, C.B.E., D.S.O., M.C., and Major-General W. R. Dimond, C.I.E., C.B.E., I.M.S. (Retd.), also spoke. Space does not permit mention of all the suggestions made, but these included the replacement of the Fordson 3-ton ambulance car by a lighter type of 4-stretcher ambulance with a low silhouette, reinstatement of the padre in the establishment of a field ambulance, revision of equipment especially with a view to man-carriage, pooling of divisional medical resources, increase in jeeps and trailers and the reintroduction of the divisional F.D.S. Opinion was divided on the need for wireless in medical units.

I wish to thank Lieut.-Colonel F. J. H. Edmunds, Royal Army Dental Corps (T.A.), for the photographs.

## AN INTERESTING CARDIAC PROBLEM

BY

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THE opportunity has been taken of reporting the following interesting and unusual cardiac case, in which the progressive varying nature of the clinical picture has suggested the possibility of several alternative diagnoses.

**Case History.**—E. A., a young National Service man of 20 years of age, was admitted to hospital on 14.11.54, having been ill for one week. His first symptoms (7.11.54) were malaise, rigors, a non-productive cough and a sore throat. In the few months prior to admission he had suffered from recurrent sore throats at about monthly intervals. On 10.11.54 he developed pain and swelling in both knees and in his right elbow. Examination showed an ill-looking, flushed and sweating youth, with a temperature of 104° F. He had enlarged and inflamed tonsils. His knees were hot and tender, both showing an effusion and restriction of movement; his right elbow was tender and painful on movement. The sole abnormality found in his cardio-vascular system was a soft, blowing, apical systolic murmur. No rheumatic nodules were found in either upper or lower limbs. Fine crepitations were heard at his left lung base, and scattered sibilant rhonchi throughout both lung fields.

Laboratory investigations at this time showed: Hæmoglobin 95 per cent.= 14.1 g. per cent.; E.S.R. 50 mm. in 1 hour (Westergren); white cell count 12,500/c.mm.—polymorphs 83 per cent., lymphocytes 15 per cent., monocytes 2 per cent. Urine showed numerous pus cells and granular casts, but culture was sterile. The throat swab gave normal throat commensals only.

A diagnosis of acute rheumatic fever was made, and he was given a course of sodium salicylate gr. 150 daily in divided doses for five days, after which the temperature subsided. Five days after admission (19.11.54), although he remained afebrile, crops of minute pustules at the back of his neck, in both axillæ, on his lower abdomen and in both groins were noticed, each pustule showing very little surrounding inflammation. At the same time the pulmonary symptoms had become worse, cough and sputum had increased, and there was more dyspnoea. Examination revealed an acute purulent tonsillitis, medium crepitations throughout both his lungs, and radiologically diffuse broncho-pneumonic consolidation.

Laboratory results (19.11.54): Culture from skin pustules gave a pure growth of *Staphylococcus albus* sensitive to aureomycin; white cell count 8,000/c.mm., with polymorphs 70 per cent., lymphocytes 25 per cent., and eosinophils 2 per cent.; throat swab gave normal throat commensals; cold agglutinins were present in the blood; blood culture was sterile; sputum culture yielded a



pure growth of pneumococci; urine—no protein or other abnormal constituents, and culture was sterile.

In view of the acute purulent tonsillitis, broncho-pneumonia and skin pustules, he was given aureomycin capsules in doses of 1 g. six-hourly. The tonsillitis and broncho-pneumonia improved, but the temperature steadily rose, and on 26.11.54 he suddenly developed some remarkable cardio-vascular signs: his pulse became collapsing in character, his blood pressure being 125/50; a pronounced diastolic thrill was felt along the left border of the sternum, and a very loud (Grade V) "whining," high-pitched, diastolic murmur, throughout early and middle diastole, and fading away in late diastole, was heard. This murmur was very widespread, being audible over the whole of the præcordium and in the neck in the region of the carotid arteries, but was maximal over the third left intercostal space. The apical systolic murmur originally detected was also louder and more diffuse, so that a continuous to-and-fro murmur ("machinery-type") was present at the base of the heart. Other findings included a palpable spleen, but there was no evidence of emboli in any system. The E.S.R. was now elevated to 114 mm./hr., the white cell count showed 9,000/c.mm., with polymorphs 81 per cent., lymphocytes 11 per cent., monocytes 5 per cent., eosinophils 2 per cent., and basophils 1 per cent. Urine examination did not show any red cells in the deposit. Blood culture was again sterile. An electrocardiograph indicated marked right ventricular preponderance and also suggested acute pericarditis.

At this juncture it was considered that the most likely diagnosis was subacute bacterial endocarditis complicating a patent ductus arteriosus. A course of intramuscular crystalline penicillin was therefore instituted on 30.11.54 in daily doses of two million units, to be continued for six weeks. After twelve days of penicillin the patient experienced a sudden sharp pain in the left hypochondrium. No splenic friction rub was heard and no other abnormal physical signs elsewhere were detected. Simultaneously, the temperature rose, being now intermittent in character and persisting for two weeks, after which it gradually subsided. During the course of penicillin therapy the cardio-vascular findings slowly changed, until at the termination of treatment a new set of physical signs was present. The collapsing pulse was very obvious, the blood pressure being 130/50; gross capillary pulsation was seen in the nail beds; the Duroziez phenomenon was present over the femoral arteries; the cardiac apex was displaced to the left, being in the fifth intercostal space  $4\frac{1}{2}$  inches from the mid-line; both the pulmonary and aortic second sounds were increased; the to-and-fro murmur at the pulmonary area was gone, and in its stead was a loud, high-pitched, blowing, early diastolic murmur, maximal in the third left intercostal space and conducted down the left border of the sternum. This murmur was typical of aortic regurgitation. The systolic murmur, however, had by this time diminished considerably in intensity. All the physical signs now pointed to marked aortic reflux, and these signs have persisted up to the time of reporting this case.

## DISCUSSION

The early history and findings in this case were compatible with a diagnosis of acute rheumatic fever, without any clinical evidence of carditis. The subsequent development, however, of the to-and-fro murmur at the base of the heart, in conjunction with splenomegaly, indicated the need for revision of the diagnosis. The possibility of a subacute bacterial endocarditis was therefore considered. It is very unusual to see this condition occur in a previously clinically normal heart. Bacterial infection is most frequently established in a valve damaged by past rheumatic fever, less often by arteriosclerosis or syphilis. It may also, of course, complicate congenital heart disease. In the present instance, in view of the continuous murmur at the base of the heart, it was believed that a patent ductus arteriosus was the site of the bacterial infection. Inflammation of the joints simulating rheumatic fever occurs in about 25 per cent. of all cases of subacute bacterial endocarditis, and interrecurrent infections, such as broncho-pneumonia, have been described in the disease. The early joint and chest findings would therefore fit in with the diagnosis. In addition, the splenomegaly and the later attack of pain in the left hypochondrium, suggesting splenic infarction, would also help to strengthen this diagnosis. Against this were the following facts: there was no evidence at all of any organic cardiac lesion when the patient was first admitted to hospital, least of all of patent ductus arteriosus; there were no petechiæ anywhere, no finger clubbing, no hæmaturia, either macroscopic or microscopic, no leucocytosis, and repeated blood cultures were sterile. The end-picture of gross aortic regurgitation makes it difficult to accept the diagnosis of patent ductus arteriosus *per se*. There is a possibility, however, that if he has had subacute bacterial endocarditis, it may have been superimposed on a congenitally abnormal aortic valve, as, for example, a bicuspid valve. This may be quite symptomless and give rise to no abnormal physical signs. After the valve had been damaged by the bacterial process, the basal cardiac murmurs could easily have appeared, and it is logical to assume that the final lesion in the heart would be aortic regurgitation.

The final diagnosis that needs to be considered is that of an acute malignant bacterial endocarditis terminating in rupture of a cusp of the aortic valve. The source of infection may well have been the purulent tonsils or the infected lungs. The skin pustules strongly suggest a pyæmic phase in the disease. The most unusual and intense character of the diastolic murmur, resembling the "whine" of a machine, can be attributed to a ruptured aortic valve cusp. This would, of course, lead to well-established aortic regurgitation. Pericarditis is not infrequent in acute septic endocarditis, whereas it is most unusual in subacute bacterial endocarditis. This patient showed electro-cardiographic evidence of recent pericarditis. In acute septic endocarditis, however, the patient is very ill, the clinical picture is primarily one of pyæmia, a substantial leucocytosis is found, and there is almost invariably a positive blood culture. None of these factors was much in evidence in the present case, but it should be borne in mind

that antibiotics may have assisted in producing negative results in the blood culture series and in modifying the clinical picture as a whole.

It will be seen, therefore, that the final diagnosis is still open to question, but the consensus of opinion, after full specialist observation and investigation, is that this patient has had a less severe form of acute ulcerative endocarditis with rupture of one or more of the cusps of the aortic valve.

#### SUMMARY

An interesting cardiac condition has been reported in which the initial clinical picture suggested acute rheumatic fever. The subsequent progress, it will be seen, indicated in turn subacute bacterial endocarditis superimposed on either a patent ductus arteriosus or a congenitally abnormal aortic valve, or finally acute ulcerative endocarditis with rupture of a cusp of the aortic valve.

#### ACKNOWLEDGMENTS

My thanks are due to Lieut.-Colonel D. S. Cochran, R.A.M.C., O.C., Colchester Military Hospital, and to Colonel J. H. Anderson, late R.A.M.C., A.D.M.S., East Anglian District. I am also grateful to Major-General R. Priest, C.B., C.B.E., M.D., F.R.C.P., and to Major-General W. R. D. Hamilton, C.B., O.B.E., Q.H.P., M.D., for their help and advice in the management of this case. Finally, I am indebted to Captain A. Grech, R.A.M.C., for his aid in preparing this case-report for publication.

## SOME MEDICAL PROBLEMS OF PARACHUTING IN MALAYA

BY

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AND

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PARACHUTING in Malaya presents problems found in no other part of the world except perhaps by the Canadian Fire Fighting Service. Some four-fifths of the land surface of Malaya is jungle-covered ; of this the greater part is primary jungle consisting of trees 200 to 300 feet in height, the upper branches of which are closely interwoven, forming a thick canopy.

Inside this deep jungle, the Communists have set up bases which they have made nearly self-sufficient by the cultivation of food gardens. In these bases the bandit troops rest and re-train, while their leaders hide and work out the directives for terrorist activities.

The Communists maintain a high degree of mobility and it is often hard to locate these jungle bases by marching to them on the ground. Parachuting therefore presents excellent opportunities for direct contact. This is an obvious advantage, but until recently trees and jungle were a parachuting hazard that was accidental rather than intentional. In the initial stages the only equipment was a 100-foot length of finger-thick rope which was knotted every 18 inches. This soon had to be abandoned because of the fatigue involved in lowering. However, in the last two years, after extensive research, a lowering device based on the mountaineering *abseilung* gear has been developed. This consists of webbing 240 feet long which can be braked through a central abdominal ring. This ring, however, was liable to ride up and constrict the upper abdomen, so now the webbing passes through "Bikini"-type canvas pants. The braking is simple and is effective by lifting the webbing up or down from the centre ring, and as this can be done by using the finger and thumb of one hand, no undue fatigue occurs. In any form of parachuting, mental tension prior to jumping is high. If morale is to be maintained, then faith in equipment is essential. This has now been achieved and jungle-jumping is no longer an experiment, but a new method of attacking the enemy.

Notwithstanding this, jumping in this form is still more hazardous than on to *terra firma*. If the parachute does not get hooked up, then the descent in the final 200 feet is by gravity, only partially retarded by the parachute as it catches in the branches on the way down. The parachute may also give way after being initially hooked up. This is perhaps the worst hazard, as by that time a man may

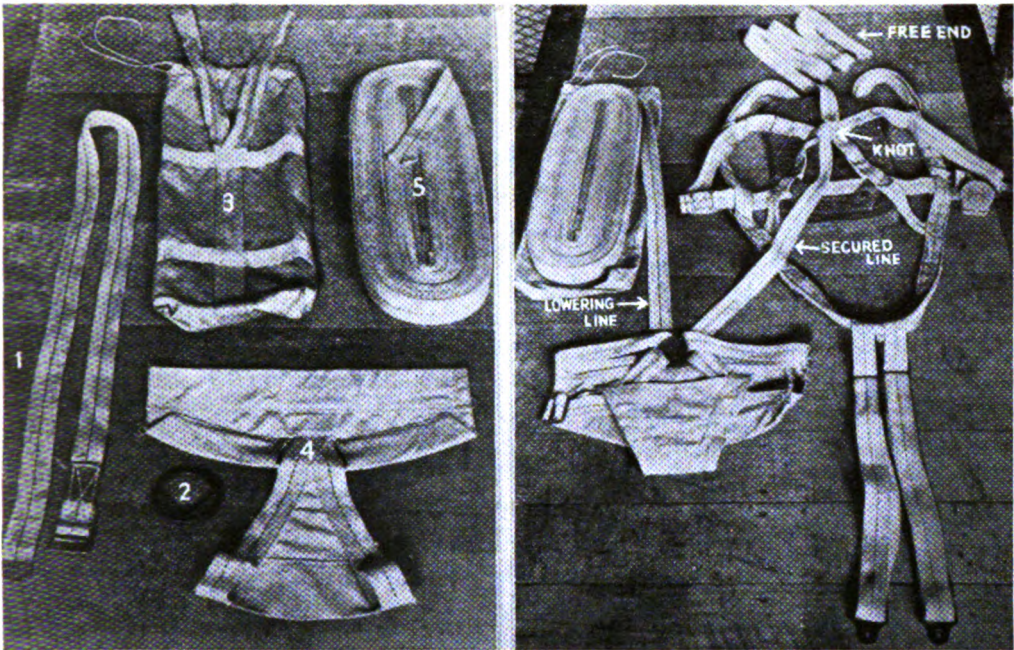


FIG. 1 (*top left*)

Equipment laid out on ground:

- 1 Waist belt for bikini.
- 2 Central abdominal ring.
- 3 Bag to contain lowering line.
- 4 Bikini.
- 5 Rolled lowering line.

FIG. 2 (*top right*)

Equipment assembled on ground.

FIG. 3 (*right*)

Equipment attached to parachute and being worn.





be out of his harness and lowering himself to the ground, when his support gives way.

Out of 995 descents, either operational or training, which have so far taken place into primary jungle, with similar dropping zone conditions, the casualty rate has been 4.6 per cent. About 75 per cent. of this figure are injuries which necessitate evacuation by helicopter within twenty-four hours. It is to be appreciated that all evacuation from deep jungle in Malaya has to be done by helicopter and that first of all trees have to be cleared by axe or explosives.

The most common injuries are to the back, usually crush fractures of the lumbar or lower thoracic vertebrae.

When a man's fall is only partially impeded, he cannot make the standard knees together and roll type of landing, because his position during the fall keeps on changing as his parachute catches and then loosens. The impact therefore commonly occurs on the base of the spine, with a fracture as the result.

The second most common type of injury is to the ankle, again usually a fracture. Sprains are to some extent eliminated by long puttees which are wound spirally around the jungle boot, supporting the lateral ligaments. Following on these are injuries to the ribs, pelvis, and clavicles or any other of the bones which come into contact with direct violence by branches or the ground. Lacerations or bruises occur but can usually be dealt with on the spot and do not require evacuation.

There has been a 0.3 per cent. fatality rate, and all these occurred in an operation nearly a year ago. A further 0.3 per cent. have been major injuries to the extent of down-grading the Pulheems and boarding home to U.K. The remaining 4 per cent. are classified as minor injuries in so much that, although they include fractures, the men have been able to return to their unit.

These casualties have further been reduced by appreciating the hazards in the dropping zone. Air reconnaissance helps to establish whether the D.Z. is rocky or boulder-strewn, or if there is cultivation made by the aborigines with newly felled timber lying criss-cross on the ground and sharp tree trunks sticking up. Recently bombed jungle presents weakened trees and spiky stumps, whilst bamboo if landed upon breaks into slivers with razor-sharp edges which can cause serious lacerations.

These, then, are some of the problems, and it is with the result of them that the R.A.M.C. has to cope. During operations medical personnel from the 16th Field Ambulance are attached to the 22nd S.A.S. Regiment and jump with the troops. In Operation "Termite" last July a medical officer jumped with each squadron of sixty men. The R.A.M.C. personnel carry more equipment than the troops; dextran infusion sets, dressing and suture materials are carried in a Bergen-type rucksack which is strapped to the chest. After the parachute opens, and whilst still in the air, the rucksack is lowered from the chest to below the feet, which can in fact be tucked in on top of it. This makes a useful bumper for going through trees. During descent the flight can to some extent be controlled so as to avoid gaps between trees or broken stumps. Very little impact or injury occurs on going through the covering canopy. If one gets hooked up, and the



majority do, then after a few seconds of breathless dangling, the lowering web is dropped and further descent continues after getting out of the harness.

Warfare in Malaya differs from that in Europe in that casualties have to be searched for and found in thick jungle where a man can be six feet away and still invisible. If the bandits are about, it is not feasible to cry out to the casualty, for fear of disclosing one's presence. However, the jumping sticks are not widely dispersed from medical cover and the casualties are always found. Immediate first aid is given ; fractures are splinted, and transfusion can if necessary be given. If the injury renders a man incapable of walking or fighting, then he must be evacuated out of the area as soon as possible. Casualties which remain in the jungle hinder the operational efficiency of the attack as men have to stay to guard the patient.

In conclusion, it must be said that most of the jumping so far has been from R.A.F. Valettas, but perhaps in the future helicopter jumps may be more used. With the absence of a slipstream, medical aid could be dropped on to a casualty from 800 feet immediately above.

# EOSINOPHILIA IN EAST AFRICAN AND MAURITIAN TROOPS

AN ANALYSIS OF 150 CASES

BY

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EOSINOPHILIA is a rare finding in British troops at home or overseas. Service doctors, however, may frequently find it in troops of other nationalities. This study has been carried out, during the course of six months' routine work in the medical wards of the largest military hospital in the Middle East, to discover the causes and degree of eosinophilia that occurred. I have been unable to trace published accounts of any similar series.

## MATERIAL

Besides the men of the British Army and local civilians, large numbers of East African and Mauritian troops have been employed in the Canal Zone of Egypt, and it is from these men that this series has been drawn. It must be emphasized that no special search was made for these cases and that all were in-patients of this hospital, eosinophilia being found in the course of routine investigation. In a consecutive series of 178 cases of eosinophilia a cause was found for 150 cases, and these form the basis of this study. In the remaining 28 no cause for the eosinophilia could be found in spite of very thorough investigation of about half of these, while the remainder were inadequately examined due to circumstances beyond my control.

Eosinophilia was regarded as being present if there were more than 250 eosinophils per c.mm. in the peripheral blood whatever the percentage of the total white blood cells, Discombe (1946) having shown that the normal range is 0-240 per c.mm. The degree of eosinophilia was divided into four grades according to the total eosinophil count as follows: Grade I (minimal) 250-499 per c.mm., Grade II (mild) 500-999 per c.mm., Grade III (moderate) 1,000-2,999 per c.mm., and Grade IV (gross) 3,000 or more per c.mm. After a total and differential white cell count had been performed, in some cases a total eosinophil count was made also (*e.g.*, in Grades I and IV) using the method described by Discombe (1946).

## INCIDENCE

**Race.** Sixty-six Africans and 84 Mauritians compose this series, the only selective factor having been the fact that all cases were personally seen by the author.

**Age.** Men in both the East African and the Mauritian groups were naturally of a similar age distribution. Allowing for 10 East Africans who did not know their age, most men were aged 19-23 years with a range of 18-50 years.

*Degree of eosinophilia.* The highest total eosinophil count that each man showed was graded. A moderate (Grade III) eosinophilia was found most frequently (Fig. 1). It was also the commonest grade in the 28 cases for which no cause could be discovered (Table 1). The highest total eosinophil count of the series was 13,900 per c.mm. in a case of ancylostomiasis.

### ÆTIOLOGY

Intestinal parasites were by far the commonest cause of eosinophilia (148 cases). Infection of the bladder by *Schistosoma hæmatobium* accounted for 6 cases, while *Acanthocheilonema perstans*, which is believed to be non-pathogenic but which causes an eosinophilia, was present in the blood of 2 East Africans. At least two causes of eosinophilia were present in some cases. Each possible cause has been recorded separately for the purpose of this study (Fig. 2).

In Fig. 3 the incidence of the various worm infestations found in this series is shown graphically. It will be seen that the commonest parasite in East Africans and Mauritians is the ubiquitous hookworm, which in the Mauritians was usually associated with the non-pathogen *Trichuris*. *Tænia* was common in the East Africans but rare among the Mauritians, whereas the reverse is true of *Ascaris lumbricoides*. No case of *Schistosoma mansoni* infection of the bowel was discovered among the Mauritians, but 9 cases occurred in the East Africans. *Strongyloides stercoralis* was found in 12 Mauritians but in only 2 Africans. The incidence of *Schistosoma hæmatobium* was low in both groups although higher in the Africans; most cases also had at least one species of intestinal parasite.

Helminthiasis does not necessarily provoke an eosinophilia. During this investigation 15 cases were found to have no eosinophilia, 5 having more than one species of worm (Table 2).

Table 1. To show distribution of undiagnosed cases according to grade of eosinophilia and race

	Total cases	Percentage in Grade			
		I	II	III	IV
East African ...	20	0	10	70	20
Mauritian ...	8	37.5	0	50	12.5

Table 2. To show the incidence of the various helminths in patients with no eosinophilia

Parasite	East Africans 6 cases	Mauritians 9 cases
<i>Tænia</i> sp.	2	3
<i>A. duodenale</i>	3	3
<i>S. mansoni</i>	1	0
<i>S. hæmatobium</i>	1	0
<i>Trichuris</i>	0	6
<i>S. stercoralis</i>	0	1

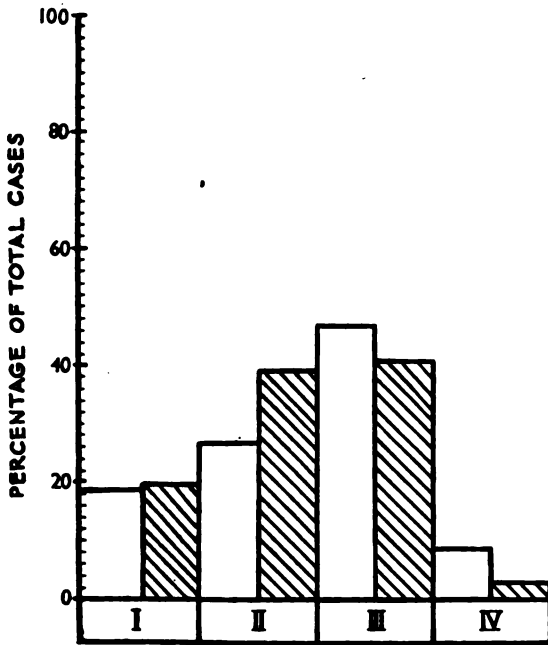


FIG. 1. Diagram to show the distribution of the four grades of eosinophilia in East Africans (plain blocks) and Mauritians (shaded blocks).

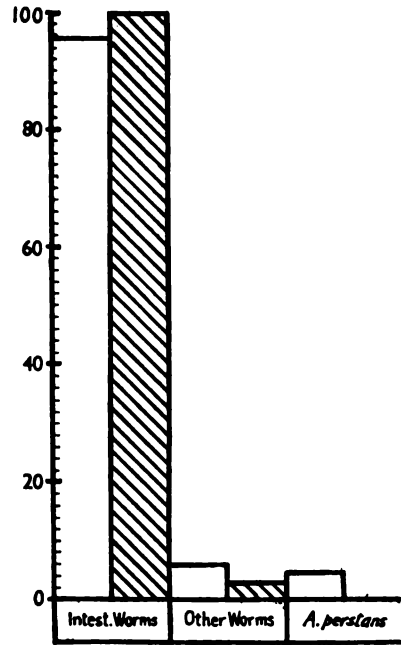


FIG. 2. Diagram to show the incidence of the causes of eosinophilia in East Africans and Mauritians.

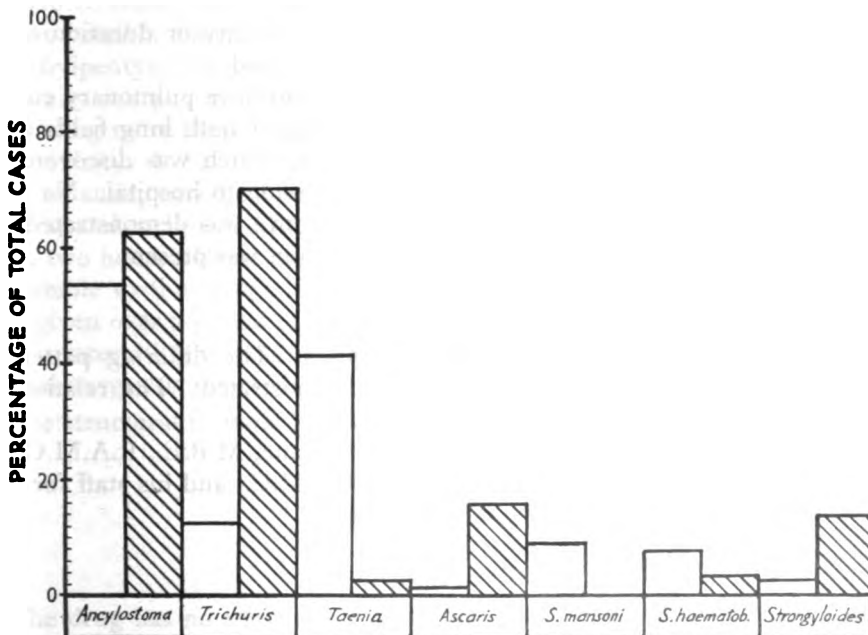


FIG. 3. Diagram to show the incidence of helminths causing eosinophilia in East Africans and Mauritians.

## ANCYLOSTOMIASIS

Ancylostomiasis often causes anæmia, but only one man was found with a hæmoglobin of less than 11.0 g. per cent. in the 90 cases seen in this series. An East African, he had 6.4 g. Hb. per cent., 2.6 M. red cells per c.mm. and a mean corpuscular hæmoglobin concentration of 27.9 per cent. (W.B.C. 5,300 per c.mm. with 33 per cent. neutrophils, 40 per cent. eosinophils, 24 per cent. lymphocytes and 3 per cent. monocytes). Cronk (1954), when working with a similar group of patients, found 7 had hæmoglobin below 70 per cent. (Haldane) out of 31 cases of hookworm infestation.

## BRONCHITIS

It was noticed during the course of this investigation that some previously fit young men were admitted to hospital with acute bronchitis, which in some cases recurred. Five such Mauritians and three East Africans had an eosinophilia for which no cause could be found and are therefore not included in the 150 cases of this series. It seems possible that the eosinophilia and bronchitis were originally caused by the migration of parasitic larvæ through the lungs before the adult female worms were present in the intestine to produce ova, but against this is the fact that they had not been home (and thus exposed to infection) for an average of 23 months (9-34 months). There is no evidence to suggest that the men were infected while serving in the Canal Zone. Extensive searches of the sputum (cleared with sodium hydroxide or trypsin) failed to demonstrate any larvæ. In some cases a proportion of the pus cells in the sputum were eosinophils, which in one case formed 70 per cent. while the peripheral blood contained only 7 per cent. No direct relationship could be demonstrated between the number of eosinophils in the sputum and the severity or duration of the bronchitis or the eosinophil count in the peripheral blood.

In addition to these, one East African appeared to have pulmonary eosinophilia in that radiologically there was some mottling of both lung fields and a small ( $1.0 \times 0.75$  cm.) solid right mid-zone opacity which was discovered on routine radiography and was the cause of his admission to hospital. No cause for the eosinophilia (total eosinophils 5,000 per c.mm.) was demonstrated, and no evidence of tuberculosis or other bacterial infection was present.

## SUMMARY

A series of 150 cases of eosinophilia is described. The differing pattern of ætiology in East Africans and Mauritians is demonstrated. The relationship between bronchitis and eosinophilia is discussed.

I am indebted to Lieut.-Colonel R. G. MacFarlane, M.B.E., R.A.M.C., for his encouragement and to Capt. M. H. King, R.A.M.C., and his staff for their invaluable help with the laboratory investigations.

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## A SHORT SURVEY OF METHYLPENTYNOL

BY

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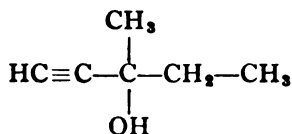
OVER the last few months there has been considerable interest aroused by the medical and the more sensational lay press regarding the "confidence" drug "Oblivon" and the possibilities it may embrace. The medical reports warrant further interest, and after trial in a few selected cases the field was extended to include a variety of procedures and diseases. This was started six months ago and nearly two hundred cases were used—a small series for the purpose. Naturally with a potentially fit Service population the numbers are not by any means large and the uses varied widely. A brief description of the drug will be given and the results obtained will be analysed. There follows a survey of the conclusions as reported from other trials.

### METHYLPENTYNOL

It is reported that certain members of the group of compounds called the simple unsaturated aliphatics possess certain features in common, but so far the one of greatest possible clinical use is the 3-methyl pentyne-ol-3, more widely known as methylpentynol or "Oblivon." It is a mild sedative hypnotic. It is distinct chemically and pharmacologically from the barbiturates. Its action is rapid and brief, being more rapidly absorbed, quickly metabolized, and having no cumulative toxicity. It has no analgesic properties, does not depress respiration and is not an antispasmodic. It appears to have a clinical action within five to ten minutes, and to be effective for about one hour. It is completely metabolized within two hours. Urine analysis and blood examination have shown no change attributable to the drug. No undesirable side effects have been noticed even when given over a period of six months.

It is interesting to note that methylpentynol consists of only carbon, hydrogen and oxygen as opposed to most known sedative hypnotics.

The structural formula is :



The drug has no attributable effects on the electro-encephalogram patterns for normal physiological sleep.

## RESULTS OF TRIAL

A total of a 194 cases were selected. They were selected for the obvious reason that there was no benefit to be derived from administering the drug to the completely stable, undisturbed patient when the whole exercise was to determine the usefulness of the drug with the apprehensive and nervous unco-operative patient. The accent was necessarily on ear, nose and throat cases and those of allied departments owing to the investigator's speciality. In all patients the administration of the drug was regarded as part of the treatment and the patient's attention was not too obviously drawn to the anticipated effect of the drug. It was thought that explanations pre-operatively might engender false results. The elixir was given in almost all cases rather than capsules so that higher doses could be given more easily if necessary and possibly more uniformity of absorption obtained. Unfortunately, the drug has a strong "spearmint" flavour which can be masked to some extent by concentrated fruit juices. It is understood that efforts to produce a better flavour have so far failed owing to the reduction of the stability of the drug. The dosages were kept uniform so that adults received 500 mg. (8 ml. of elixir or two capsules) and children 250 mg.

Out of a total of 105 antrum punctures good results were obtained in 85 cases, the operator feeling that the patient was not uneasy, and there were no after-effects or "hangovers." In 13 cases there was slight subjective sensation from the drug, in 7 no effects at all. No cases showed side effects. Similar results were obtained in cases for removal of nasal polypi, cauterization of nose, and in a few other minor procedures. In removal of tonsils and adenoids by the dissection method premedication consisted of atropine and methylpentynol. Twenty-five cases were observed. In two cases the methylpentynol was given ten to fifteen minutes prior to going to the theatre, but in the remainder this was extended to an hour. It was considered that the troublesome nausea experienced earlier would be reduced, and when used as a premedication absorption appears to be significantly slower. Although the children were not necessarily asleep on arrival in the theatre, induction of anaesthesia was smooth. There were no after-effects except in two cases where the premedication had been given early. Post-operative vomiting occurred, but with an increased time interval this was overcome. As an hypnotic in patients who had hitherto taken barbiturates, methylpentynol was used successfully over long periods. This was in home conditions and would most probably be unsuccessful under ward or institutional conditions in producing the required sleep.

In three out of four asthmatics with an asthmatical attack the results were surprising, but there was no response at all in the one case. In dental cases the drug seems to have a definite advantage, and dental officers report that it has its use not only prior to extraction but also in the examination of recruits, some of whom have never seen a dentist before and are especially apprehensive. Two bronchograms were done with success, one of which had previously failed due to the patient's nervousness and lack of co-operation. Two patients with mild tinnitus following trauma were helped in getting off to sleep, with no after



effects. Throughout the series the patients were carefully observed prior to giving the drug and questioned afterwards and in a good many cases questionnaires were completed. Such reports as "I wish I always felt the same," or "I always faint when I have my T.A.B. injections," were all too common.

*Table of results of trial*

Type of case	Total	Good results	Some useful effects	Side effects	No effects
Antrum washouts ... ..	105	85	13	0	7
Nasal polyp ... ..	7	5	2	0	0
Nasal cauterisation ... ..	15	12	3	0	0
Tonsils, adenoids (children)	25	20	3	2	0
Circumcision (children) ...	2	2	0	0	0
Asthma ... ..	4	3	0	0	1
Dentals ... ..	30	25	4	0	1
Bronchogram ... ..	2	2	0	0	0
Hypnotic, long term ... ..	2	2	0	0	0
Mild tinnitus—hypnotic ...	2	2	0	0	0
<b>Total ... ..</b>	<b>194</b>	<b>158</b>	<b>25</b>	<b>2</b>	<b>9</b>

### SURVEY OF THE LITERATURE

This survey covers the more important literature published on methylpentynol and reveals the differing opinions on the real usefulness of the drug.

Bourne (1954) conducted an investigation into methylpentynol in labour and found no contraindications, and noted that patients with fear and apprehension of such a degree that they would have been difficult to handle, or would have required an increased amount of sedation, seemed to respond best. Young (1954) reports increased post-operative restlessness occasionally in children following eye operations, but was very encouraged by the pre-operative state of the children. Satisfactory results with electro-encephalography in children were obtained by using the drug as a mild sedative in doses up to 750 mg. (Tükel & Tükel, 1952). Tuberculous children were reported by Malone, Klimkiewicz & Gribetz (1952) to gain more than twice as much weight in four months than those not receiving the drug. This they attributed to relief of tension and wakefulness.

Trotter (1953) found that 42.5 per cent. of patients were apprehensive prior to extractions under local anæsthesia, while with the use of methylpentynol 94.5 per cent. of patients were entirely freed of apprehension. 500 mg. were given ten to fifteen minutes prior to administering the local anæsthesia. Psychological effect of administering the drug was ruled out by the use of a control capsule containing an inert substance. There were no toxic or after effects in any patients.

Glatt (1954) gave 250 mg. to 1,250 mg. to a series of fifty alcoholics in an institution to induce sleep. The results were not unsatisfactory and those who had wakeful nights said they felt calmer and relaxed and went to bed less fearful of possible sleeplessness. No harmful side effects were noted. Most of

the patients after a few weeks were able to sleep without sedation. Boag (1954) found no success using methylpentynol as an alternative to barbiturate hypnotics, particularly with the customary nocturnal noise of hospital wards, but thought it might be useful in patients' homes for treatment of insomnia. He did, however, note success in a number of ward procedures such as lumbar punctures, paracenteses and biopsies.

Davis (1954) also found that in confirmed barbiturate addicts it was difficult if not impossible to wean such patients on to methylpentynol. He thought the indications differed and considered methylpentynol permitted sleep by counter-acting mild emotional tension rather than by inducing sleep as do the barbiturates. Exton-Smith (1954) used the drug to allay the anxiety prior to administration of a barium enema. The radiological examination was facilitated by the patient's fullest co-operation. He also gave methylpentynol to asthmatics in four-hourly doses as long as the attack lasted.

May & Ebaugh (1953) found favourable results as a sedative in elderly patients where the mental confusion of barbiturates was overcome. Christine Rendell (1954) reported 62 cases of premedication before removal of tonsils and adenoids in children. She found the drug filled the desired requirements but failed to produce sleep. The children, however, arrived in the anaesthetic room without exception quite happy, co-operative, and sometimes sleepy. The elixir was given at one and a half hours pre-operatively and in the dosage of 500 to 750 mg.

It is now found to be useful in migraine in abating the attack at the onset. There has been evidence to suggest the use of methylpentynol in stammering, travel sickness, and in mild sexual neuroses.

### CONCLUSION

While the trial described here is small and limited, the review of the literature leaves no doubt as to the already proven usefulness of methylpentynol in such clinical applications as minor surgery, alcoholism, obstetrics, dentistry, etc. It seems likely, too, that the field may be extended even more, especially with the development of the drug or its biochemical allies.

The popularity of the drug in the lay press arises, of course, from the social uses which cannot be ignored—*e.g.*, prior to interviews, examinations and public appearances. It is interesting also to envisage a likely use of the drug or some similar combination in times of apprehension or need for building morale under circumstances of atomic warfare, assault landings, paratroop training, etc.

The whole essence of the indications for methylpentynol must be a state of apprehension or nervous tension for which the drug appears to be a specific.

Toxicity is practically absent, and two deaths so reported were in point of fact cases where more than one barbiturate in addition had been involved.

I would like to thank British Schering Ltd. for their liberal supply of the drug and for their kind co-operation.

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## A CASE OF BRUCELLOSIS WITH NEUROLOGICAL COMPLICATION

BY

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BRUCELLOSIS is common in East Africa and several cases have been seen in both British and African troops during the past year.

The clinical picture of the neurological complications of undulant fever has been fully reviewed by Nelson-Jones (1951), but the association of central nervous system damage and this disease appears to be uncommon in Kenya. Wright, Cooke & d'Souza (1953), record only one case with slight meningitis in a review of 70 cases observed between 1948 and 1952.

### CASE HISTORY

A British officer aged 35 was admitted to hospital on 14th January, 1955, with two weeks' history of fever, malaise, headache and muscle pains. The muscular pains were mainly present in the trunk and upper limbs. On admission his temperature was 99.4° F. but examination showed no other abnormalities. The spleen was not palpable and there were no signs of C.N.S. involvement.

The results of investigations were as follows: W.B.C.—4,250 per c.mm. (N 46%, L 44%, M 4%, E 6%); E.S.R.—3 mm. in 1 hour; chest radiograph—normal; agglutination tests (15/1/55)—Widal, not significant; Weil-Felix, not significant; *Brucella abortus*, 1 : 10,240; *Brucella melitensis*, 1 : 640.

During the next 48 hours he continued to run a pyrexial course (up to 101° F.), but cultures from the blood, faeces and urine grew no pathogens and repeated blood films showed no parasites. On 18/1/55 he was still complaining of aching in the muscles of the shoulders and both arms, and at this stage examination of the central nervous system revealed only a moderate nuchal rigidity. Lumbar puncture (18/1/55) revealed a clear fluid under no increase of pressure. Cells, 58 per c.mm.; protein, 140 mg. per 100 ml.; chlorides, 714 mg. per 100 ml.; culture was negative. The following day the patient noticed weakness of the right arm which was found to involve the abductors and extensors. There was no sensory disturbance.

In view of the high agglutination titre a ten-day course of aureomycin was started. Two grams daily, in divided doses, were given, but this was reduced to 1 gram daily after three days on account of diarrhoeic symptoms.

There was marked improvement in the general condition within 48 hours. The temperature fell, and remained at normal level while the muscular pains eased. There was little change in the degree of paresis of the right arm and no evidence of spread. On discharge to out-patient physiotherapy on 12th February,

1955, there was still marked weakness of abduction and extension of the right arm with some diminution in the triceps and biceps jerks on this side.

He was seen again in the out-patient department on 15th March, 1955. On this date he felt extremely fit, but still had weakness in the right shoulder muscle group and some wasting was now evident.

Brucella agglutinations now were :

*Br. abortus*, 1 : 640

*Br. melitensis*, 1 : 20

#### COMMENT

Although a virus disease might be postulated as a cause of the paresis it is thought that the lengthy history of pyrexial illness and muscular pains before the onset of paralysis makes this unlikely. Nelson-Jones (1951) states that some neurological signs may be late in appearing and slow in recovery in brucellosis.

Although both blood and C.S.F. culture were negative in this case the high blood titre to *Br. abortus* is considered to be diagnostic and the response to treatment with aureomycin would appear to support a diagnosis of brucellosis.

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## Correspondence

*From Major F. G. Neild, Royal Army Medical Corps*

Sir,

### *Desert Rescue: The Parachute Medical Team*

The article by Dr. Macdonald in your January (1955) issue stimulates me to record that the Airborne Division of the old British-Indian Army had developed parachute medical teams as early as 1945.

Following VE Day, considerable redeployment of forces took place from Europe to S.E.A.C. This movement was greatly aided by air transport with the latter part of its route crossing the sandy wastes of Sind and Rajputana. Thus arose the necessity for organizing parachute medical teams for desert rescue.

The organization and equipment of the team was evolved by the A.D.M.S., Colonel P. Ross Wheatley, D.S.O., and each field ambulance of the division, 7th, 60th and 80th Indian Parachute Field Ambulance (Combined), was on call for a month at a time.

Although these teams were never called on for their primary role, mixed regimental and medical teams (Operation "Mastiff") were, in August 1945, parachuted, to assist allied P.O.Ws., into Malaya, Thailand, French Indo-China and the Dutch East Indies.

I am, etc.,

ERIC NEILD.

ARMY SCHOOL OF HEALTH,  
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*From Lieut.-Colonel F. M. Lipscomb, O.B.E., F.R.C.P.,  
Royal Army Medical Corps (Retd.)*

Sir,

I was most interested in Colonel McKelvey's account, in the July number of the JOURNAL, of an attack of transverse myelitis after T.A.B. inoculation. Although such cases are undoubtedly very rare, I was surprised to learn of the extreme paucity of records of them. This excuses me, I feel, in bringing to notice a case I saw some fifteen years ago, in spite of the fact that, owing to loss of my case records during the war, I have not enough detailed particulars to write it up properly.

I saw the patient at a visit to the Indian Military Hospital, Rawalpindi. He was a rather poor physical specimen belonging to an Indian labour unit. This class of personnel was not recruited in peace time, and I left India in 1941, so the year would be 1940 or 1941.

The few facts I remember are that the condition was a typical acute transverse myelitis in the upper dorsal region, which proved fatal. The patient had had T.A.B. inoculation with a moderately severe reaction about ten days before the onset of paralysis—whether it was a first or second dose I do not recall. This was the only ætiological factor we could discover.

I remember thinking at the time how closely the clinical features resembled those of a case of transverse myelitis following antirabic treatment, which I had seen a few years before.

I am, etc.,

F. M. LIPSCOMB.

ROYAL HOSPITAL,  
CHELSEA.

*From Major J. Attenborough, Royal Army Medical Corps (T.A.),  
R.M.O., 5th Battalion The Queen's Royal Regiment.*

Sir,

I have read with interest the article "The Revision of the Regimental Medical Pannier," by Captain N. E. Shaw, R.A.M.C., in the JOURNAL of October, 1955.

I quite agree with the main points and am glad to see that the War Office is considering the new pannier.

Another piece of equipment in need of revision is the "scissor, stretcher-bearer." These are usually blunt and inefficient and, if badly made, quite useless.

I have used the German pattern *Kleiderschere*, both during the war and in general practice, and consider them much superior.

I hope the committee will also review this essential item of the regimental aid post.

I am, etc.,

JOHN ATTENBOROUGH.

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## ***Book Reviews***

**CLINICAL PATHOLOGY IN GENERAL PRACTICE** (from the *British Medical Journal*).  
Publishers—B.M.A. Pp. 314 and an index. 21s.

This series of articles culled from the *British Medical Journal* from October, 1953, to July, 1954, has been put together in a palatable fashion and should be of great use to medical officers.

So often the medical officer is at loss to know in what form or manner to send specimens; he either has to waste time getting in touch with the pathologist or send the specimen as he thinks it should be sent, which does not always agree with the pathologist.

This book supplies a long-felt want, making the position clear, and is also helpful in suggesting the exact tests to be asked for in various situations.

The book is by no means to be ignored by the pathologist. Many chapters give excellent advice from his end; for example, the chapter on Laboratory Control of Chemotherapy.

Altogether this is a publication of great use in clinical medicine and surgery.

L. R. S. M.

**A PRACTICAL MANUAL OF DISEASES OF THE CHEST.** By Maurice Davidson, M.A., M.D., F.R.C.P., with the assistance of John H. Friend, M.D., M.R.C.P.  
Oxford University Press. Pp. x+647 with 255 figures. 84s.

Since the last edition of this classic book, advances in antibiotic therapy and thoracic surgery have been rapid, calling for revision after only five years. As the result of modification in the clinical picture of lung diseases by modern treatment, many alterations in the descriptions have been necessary. The result is an up-to-date, complete and essentially practical survey of the subject.

The pathology essential to a practising physician has been carefully selected so that the main emphasis is on clinical medicine, a most welcome balance. The inclusion of illustrative case histories and temperature charts is most effective.

About a quarter of the text is devoted to a survey of pulmonary tuberculosis.

The quality of the illustrations is high and the reproductions of radiographs of beautiful clarity.

This book is strongly recommended to all practising physicians and particularly those interested in chest diseases or studying for a higher examination. It is not only a book of reference but also a readable and practical manual.

J. P. B.



**A TEXT-BOOK OF MEDICINE FOR NURSES.** By E. Noble Chamberlain, M.D., M.Sc., F.R.C.P. Oxford Medical Publications. Pp. 492. Illustrated. 30s.

The text of this book has been considerably modified since the last edition in 1949, but the familiar layout and the excellent illustrations remain. The result is an up-to-date comprehensive text-book for study or reference.

Useful features are the chapter on therapeutics and the tabulated summary for revision. The quality of production and printing is first class. The book is strongly recommended for use by senior nurses and sister tutors.

J. P. B.

**A THERAPEUTIC INDEX.** By C. M. Miller, M.D., M.R.C.P., and B. K. Ellenbogen, M.D., M.R.C.P. Pp. xii + 148. First Edition. London : Baillière, Tindall and Cox. 12s. 6d.

This little book will be most useful for newly qualified doctors puzzled by many therapeutic problems, and for practitioners requiring a brief, up-to-date review of treatment. The alphabetical arrangement makes for easy reference and detail of clinical procedures—*e.g.*, chest aspiration, lumbar puncture—is given.

Its value is much greater than the familiar "pocket prescriber."

In size it is most convenient, fitting snugly into the pocket of a hospital coat or jacket.

J. P. B.

**HANDBOOK OF FIRST AID AND BANDAGING.** By A. D. Belilios, M.B., D. K. Mulvany, F.R.C.S., and K. F. Armstrong, S.R.N. 4th Edition. Pp. xii + 464. 200 illustrations. London : Baillière, Tindall and Cox. 8s. 6d.

This book on First Aid covers the subject exhaustively and with a great wealth of detail. It represents an ambitious project and strives to be helpful to the beginner and the advanced student, but it is felt that the beginner will be bewildered by the extensive anatomy and physiology chapters, and the many alternative methods which are given. In many places, although the First Aider is warned to secure medical aid, extensive and prolonged methods of treatment, which do not properly come within the province of First Aid, are described and also the late complications of many conditions are discussed in detail. Nevertheless, for instructors in First Aid this book undoubtedly includes in one volume all the known facts and myths about the subject. There are several minor inaccuracies, most of which do not militate against the value of this book.

The Thomas's splint is described as having been devised originally for the treatment of fractures of the femur whereas in fact it was designed for treatment of tuberculosis of the knee by the late H. O. Thomas and only adapted to its present use during the 1914-18 war.

It is debatable whether the extensive detail of the anatomy of the brain is really of value in understanding the treatment of head injuries, and one cannot agree with the tremendous stress laid on recumbency and rest for three weeks

in concussion, as this is more likely to result in permanent psychogenic headache and in any case hardly comes under the province of First Aid.

It is interesting to see that in 1955 the sun's rays are still given as a cause of heat stroke. Drowning is still regarded as merely another form of asphyxia and the great importance of the immediate commencement of artificial respiration without wasting a second in draining the lungs or moving the patient is not stressed.

Carbon monoxide is stated to resemble carbon dioxide poisoning in its symptoms, signs and effects. The extremely dangerous nature of carbon monoxide compared with carbon dioxide is not, however, stressed and, curiously enough when compared with the wealth of detail exhibited elsewhere in the book, there is no description of its mode of action.

The chapter on emergency delivery is excellent and should prove of immense value to ships' officers and air hostesses, on whom, to judge by the papers, this duty so often devolves.

In view of the excellence of the official manuals of the Red Cross and the St. John organizations the value of this book would appear to be limited. It may, however, appeal to lay teachers of First Aid who require a yet more extensive work, and to persons likely to be far from medical aid.

J. C. W.

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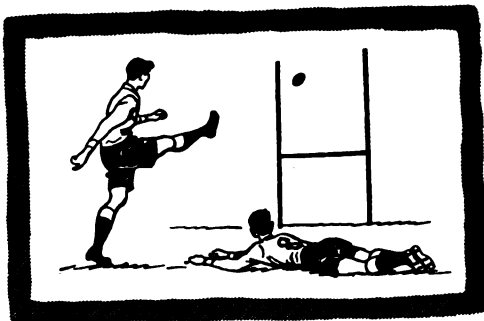
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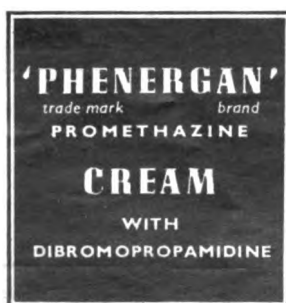
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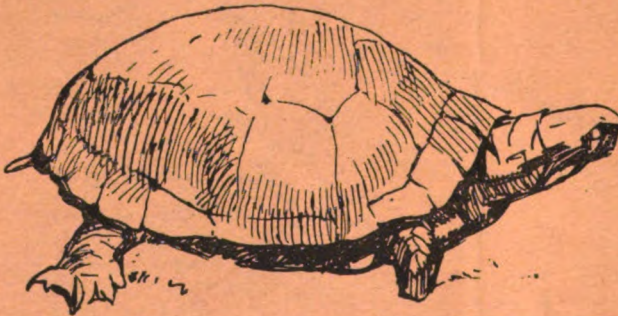
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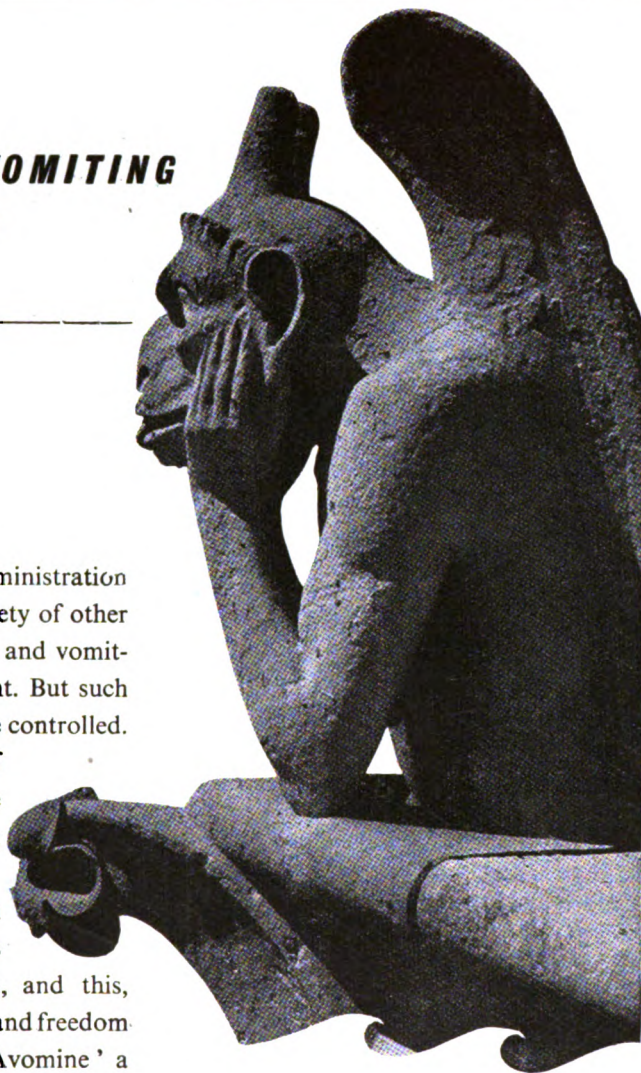
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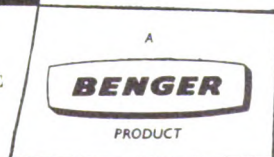
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## ENDOCRINOLOGICAL INVESTIGATIONS IN MILITARY PSYCHIATRY\*

BY

Brigadier J. T. ROBINSON, O.B.E., Q.H.P., M.D., D.P.M., D.T.M.&H.

MUCH interest has been taken in endocrinological investigations in psychiatric disorders in recent years and many papers have been published on this subject. While many researches have been carried out and facts elicited regarding endocrine disturbances in mental illness, there is no agreement on the significance of these findings and their value in therapy.

Such researches have been stimulated by the common occurrence of mental illness in association with recognized clinical disturbances of the thyroid, adrenal cortex and other ductless glands; the finding of endocrine dysfunction in mental patients; the occurrence of deviant behaviour following the administration of some endocrine product; and the greater frequency of mental illness at adolescence, the puerperium and climacteric.

The significance of the association of mental illness and endocrine disturbance is complicated, however, by the fact that many patients with obvious clinical signs of endocrine dysfunction present no evidence of psychiatric disorder. Furthermore, there is no psychiatric syndrome specific to any particular endocrine disturbance; and indeed none would be expected since it is common knowledge that the type of mental illness is dependent on basic personality. There is some evidence, however, that those who have a disturbance in biological equilibrium, as indicated by endocrine disturbances, are more vulnerable to stress and more liable to become mentally ill.

The demonstration of endocrine disturbances in psychiatric patients does not

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\* A paper read before the South Western Regional Branch of the Royal Medico-Psychological Association, held at the Royal Victoria Hospital, Netley, on 27th October, 1955.

justify the claim that there is a causal relationship with the mental symptoms, and indeed it is often difficult to assess their relative importance. Nor is it certain in what way psychic events can influence endocrine function, although, as is recognized, amenorrhœa can follow emotional upset and hypopituitarism sometimes occurs with anorexia nervosa.

Deductions about psychopathological findings and endocrine disturbances have been made in the past solely on the basis of psychiatric syndromes observed in fully developed endocrine disturbances, but have not been generally accepted. Claims regarding the therapeutic value of hormones in specific psychiatric syndromes were discredited, and for years little or no further research in this direction was attempted. Furthermore, the methods used were often crude and unreliable. In recent years, however, considerable advances have been made and more precise tests evolved for assessing specific hormone function. There is every reason to believe that more refinements will be discovered and tests will become more and more precise and specific in the future.

The discovery of isotopes and the development of radio-active tracer methods have opened up a new field and has made it possible to detect clinically unsuspected thyroid dysfunction on the basis of  $^{131}\text{I}$  uptake. Adjusting this method for use in psychiatric patients, Reiss *et al.* (1953) screened the thyroid activity of mental patients and found that on an average about 20 per cent. of the patients showed values outside the normal range. In a significant number of cases in which the thyroid indices were abnormal before treatment, normalization of the thyroid accompanied mental improvement. Their results showed that a particularly high rate of thyroid underfunction was found in male anxiety states, while female anxiety states and acute female schizophrenics frequently showed hyperfunction. Reiss (1953) has found that it was possible using the tracer method and B.M.R. investigations to differentiate cases with thyroid hypofunction from those who showed normal thyroid activity and a reduced B.M.R., a discrepancy indicating decreased peripheral sensitivity to thyroid hormone (Hemphill, 1953 ; Reiss & Haigh, 1954). The existence of such states has been repeatedly claimed in the past (Langfeldt, 1926 ; Hoskins & Sleeper, 1929), but can only now be detected with the improved methods.

Improved methods of assay of steroid metabolism have also thrown some light on previously unrecognizable disturbances of the adrenal cortex in association with psychiatric disorders. Reiss *et al.* (1949) investigated the urinary steroid excretion in a case of manic-depressive psychosis. Their results showed that the onset of depression appeared to be accompanied by the excretion of a high proportion of the beta-fraction of the 17-ketosteroids and a low cortin excretion rate ; while the reverse changes took place during the manic phase. They further noted that the inverse relationship between beta-steroids and cortin excretion remains a constant feature. These findings were confirmed by Bryson & Martin (1954).

Hemphill & Reiss (1950) have found evidence of abnormal responsivity of the adrenal in schizophrenia and other forms of psychosis, and their results have been confirmed by Hoagland (1953).



Strauss *et al.* (1952) have reported improvement in some schizophrenic patients with predominant immaturity and social inadequacy treated with dehydroisoandrosterone, the main component of the beta-fraction of the 17-ketosteroids. There was a general tendency in such cases to show an abnormal 24-hour urinary excretion rate of 17-ketosteroids with predominantly subnormal beta-fractions indicating one aspect of adrenal cortical activity. In some of these patients the drug appeared to increase self-confidence, while in others it tended to increase aggressiveness. The authors suggested that it might be of value in the constitutionally inadequate and anxious patients with a tendency to schizoid psychopathy. At the same time Sands & Chamberlaine (1952) produced further evidence of the value of this drug in the treatment of selected adolescents and of its risks in those with aggressive tendencies.

It is perhaps not irrelevant to emphasize that military psychiatry aims at getting the psychiatric service hospital patient back to duty, and failing that, to return him to civilian life capable of earning a living as he did prior to service. To this end all recognized therapeutic investigations and treatment are carried out in this, the Royal Victoria Hospital, Netley. These include all the accepted abreactive techniques, the use of chlorpromazine, modified insulin, electroplexy and deep insulin coma therapies. Treatment is dictated on a careful assessment, supported by requisite psychometric tests and pathological investigations together with detailed personal and family history. These conservative methods are largely empirical, and while in many cases the presenting mental disturbance is relieved, present clinical knowledge indicates that a recurrence is likely should the patient remain in the service.

The researches outlined above and the conclusions reached seemed to indicate that endocrinological investigations would reveal unrecognized disturbances of equilibrium which might contribute to further information about mental illness. Such might assist in adding to our meagre knowledge of etiology, indicate a better rationale for treatment, and possibly help to increase the recovery rate among psychiatric casualties and decrease the invaliding rate in the army. It also might contribute towards new methods of prevention.

It is not suggested that endocrinological disequilibrium is present in all psychiatric disorders. Indeed the published papers from Bristol Mental Hospitals on this subject reveal that in chronic patients, particularly in schizophrenics, there are little or no abnormal endocrinological findings. As yet there is little published regarding acute mental disturbances and associated endocrine dysfunction which would permit any general conclusions. From the literature available, and from our own experience, mental patients can be conveniently divided according to endocrinological findings into three main groups :

- (a) Those suffering from psychiatric syndromes in whom no abnormal endocrinological disturbances are found.
- (b) Those psychiatric patients with concomitant endocrinological disturbances whose hormone equilibrium returns to normal in the protected environment and with the nursing care and attention in hospital.

- (c) Those mental patients with endocrinological disturbances whose hormonal imbalance is apparently unaffected by normal routine treatment or environmental care and attention of a hospital ward.

It is evident that only in this the third group is there a place for considering hormone therapy on the basis of biological findings. Such therapy would be directed towards normalizing the endocrine dysfunction either by replacing a deficiency of a particular hormone or by depressing an over-acting gland according to which predominant abnormality is found. This rational line of treatment appears logical, but it does not postulate that the mental state will be improved in all cases thereby.

The literature already quoted seems to indicate that there are a number of cases in which changes in the mental symptoms of a patient are accompanied by corresponding changes for better or worse in endocrine function. In view of the close correlation between biological equilibrium, pre-morbid personality and precipitating cause, it would seem logical to conclude that where endocrine dysfunction correlates with changes in the severity of the psychiatric symptoms, then restoration of endocrine equilibrium would be beneficial to the mental state. Indeed it has been found in such cases that normalizing of the endocrine disturbance is associated with a concomitant improvement of the mental condition of the patient.

In others, however, there appears to be no correlation between the endocrine disturbances and the psychiatric disorder. It does, however, seem logical to attempt to repair the hormone dysfunction. The fact that the patient may not show much improvement following such a rationale, should lead the psychiatrist to reassess the patient and be critical of his previous psychotherapeutic methods.

The number of cases for which endocrine therapy would be indicated and be beneficial would therefore be small in comparison with the total psychiatric population in any mental hospital pursuing such investigations. Hemphill (1955) has emphasized this, pointing out that in a series of 150 recent and chronic psychotics, including some psychoneurotics, treated on laboratory indications at the Bristol Mental Hospitals, only 12 showed a significant improvement considered to be due to hormone therapy. If even this small number could as a result of these investigations and hormone treatment be restored to their normal adaptation to life, such researches are well worth doing.

The evidence of psycho-endocrinological relationships other than those in inadequate personalities appear to have been derived mainly from work on chronic patients or those with a long history of psychiatric complaints. Little or no work has been done on endocrinological investigations on patients with acute psychiatric disorders. Furthermore, difficulties have been encountered in obtaining adequate controls to validate results.

Since mental patients in the army suffer mainly from acute psychiatric disorders of fairly short duration, and as controls could be made available, it seemed worth while to attempt to evaluate the positive or negative usefulness of these investigations and their value in therapy in this hospital.

The investigations have been limited by administrative factors and laboratory facilities. They have been confined to the assessment of thyroid and adrenal cortical function, made possible by improved laboratory techniques. Such investigations readily provide information not only of primary dysfunction in these glands but also indicate when such dysfunction is secondary to a primary disturbance in the pituitary anterior lobe.

The evaluation of thyroid activity was based on the method of Haigh & Reiss (1950), and of Reiss *et al.* (1952) in Bristol following an intravenous injection of 25 microcuries of radio-active iodine in 5 ml. normal saline. The assessment was based on two parameters.

1. The  $^{131}\text{I}$  uptake slope represented by "k" during the first hour after injection. This parameter alone, according to the evidence available, is suitable only for assessment of thyroid over-activity ("k" over 3.0) since in some anxious and excited patients the uptake slope may be reduced owing to circulating vaso-constrictor substances.
2. The 24-hour  $^{131}\text{I}$  uptake of the thyroid as measured by the Toroidal Ring Counter produced by Haigh & Reiss (1950) for use in psychiatric patients. The normal Ring Count (R.C.) was taken as between 25-50 per cent. in accordance with recent authorities.

In the majority of cases (80 per cent.) there was agreement between the "k" and "R.C." values, and in such this was calculated as an index of thyroid function known as "It," the normal range of which was found in Bristol to be between 1.7 and 7.1. These findings compare significantly with the generally accepted range of the B.M.R.

The disadvantage of the method is that repeat investigations can only be made at intervals of three weeks to ensure that the previous injection does not interfere with the new test.

In some cases where the "k" value was greatly increased, the "R.C." value after 24 hours was within normal range, the summit of the uptake slope having been reached some time between 12 and 20 hours. In such cases the first hour uptake slope "k" was taken as the indication of thyroid function.

In assessing adrenal cortex activity, attention has been directed to the total 24-hour urinary excretion of 17-ketosteroids, various ketosteroid fractions, and corticoids. All these investigations have not been completed in every case, and therefore reference will only be made to total 17-ketosteroids excreted in the urine in 24 hours, determined by the method of Callow & Callow (1939). Ranges of normality vary widely according to different authors (Spence, 1953). The daily output for each individual is fairly constant, however, and increases from nil at birth to a maximum at 18 years, being maintained thereafter until middle age, after which there is a sharp decline. A range of 7-17 mg. per 24 hours has been used for the age group concerned and conforms to that generally accepted.

Investigations started in this hospital in September, 1954, with the assessment of the thyroid activity of newly admitted psychiatric patients after diagnosis had been agreed between two psychiatrists, supported by any necessary psy-

chometric tests and pathological investigations. In a parallel series the thyroid activity of normal R.A.M.C. personnel was determined and continues, in order to provide controls against the patients.

Some 380 investigations of thyroid function have been carried out so far, of which 110 are controls and 270 patients; only a small number had B.M.R. determinations. The distribution of the thyroid index in this very small series appears to follow the pattern of that found by workers in the mental population of Bristol Mental Hospitals. Psychiatric casualties between the ages 18 and 21 years showed a greater number of variations than controls in the same group as illustrated in Table 1.

Table 1. *Thyroid activity: age group 18-21 years*

	Total Number investigated	Number in normal range	Number below normal range	Percentage below normal range	Number above normal range	Percentage above normal range
R.A.M.C.	78	68	4*	5.1	6†	7.7
Psychiatric patients	131	97	18‡	13.7	16§	12.2

\* Lowest 24-hour uptake: 20 per cent.

† Highest It: 12.4

‡ Lowest 24-hour uptake: 4.2 per cent.

§ Highest It: 18.3

This table has been statistically analysed, and the result illustrated in Table 2 indicates some significance.

Table 2. *Statistical evaluation of Table 1*

	Number within normal range	Number without normal range
R.A.M.C. ...	68	10
Patients ...	97	34

*2 × 2 Table showing the incidence of subjects falling within or without the normal range of thyroid index in R.A.M.C. controls and psychiatric patients.*

$\chi^2$  (d.f. = 1) = 4.318. Significant at  $p = 0.05$   
(Yates correction applied).

It is difficult, of course, to prove in these patients, as has been stressed by other writers (Reiss *et al.* 1953), whether the thyroid deviation is primary or secondary to the mental disturbance.

The total 17-ketosteroids have been estimated in 98 patients and 22 controls, involving an analysis of 863 urine specimens. Combined investigations of thyroid activity and total 17-ketosteroids excreted in 24 hours have been carried out in 48 patients; all patients were under 30 years of age. The length of service prior to break down is shown in Table 3.

This Table 3 shows that the majority of patients were admitted to this hospital well after their first six months' service. This is long after the time of initial stress which all recruits face in their first few weeks in the service. The

Table 3. *Periods of service at which patients broke down in the army*

Period of Service	Number
Under 1 month	4
2-6 months	6
6-12 Months	10
1-2 Years	10
2-5 Years	8
Over 5 years	10
Total	48

precipitating factors were numerous and varied widely in each case. In some they appeared to be slight.

This number (48) may appear small, but it must be realized that as much time has to be devoted to the administrative details for work of this nature as to the actual tests. For example, all results of thyroid investigation in patients and controls in one week had to be discarded because of deterioration in the radio-active iodine. For a period all tracer work had to stop owing to faults in the machine and toroidal counter. On another occasion two patients showed an unsuspected and exceptionally low uptake of tracer iodine, which was soon explained when the investigator realized the patients were the unwilling recipients of a terrifying ghost story being told outside the tracer ward but within hearing range of the patients. Our experience leads us to the conclusion that reliable assessment of thyroid function with  $^{131}\text{I}$  can only be obtained under conditions suitable for measuring the B.M.R.

Furthermore, the rail strike interfered with carefully arranged plans for final assessment of 17-ketosteroids for which we depended on the staff of the Biochemical and Endocrinological Research Laboratory at Barrow Gurney, Bristol.

Some illustrative case notes depicting endocrinological findings in association with mental symptoms will now be presented.

#### GROUP A

*Patients in whom no abnormal endocrinological disturbances were found.*

This group consisted of 18 patients, of whom 7 were schizophrenics, 4 anxiety states, 4 immature personalities, 2 homosexuals and 1, a mental dullard.

#### GROUP B

*Psychiatric patients in whom there were concomitant endocrinological disturbances, whose hormone equilibrium returned to normal in the protected environment and with the nursing care and attention in hospital.*

There were 8 patients in this group, of whom 2 were schizophrenics, 5 anxiety states and 1 a psychopathic personality. This group can be illustrated by the following three cases.

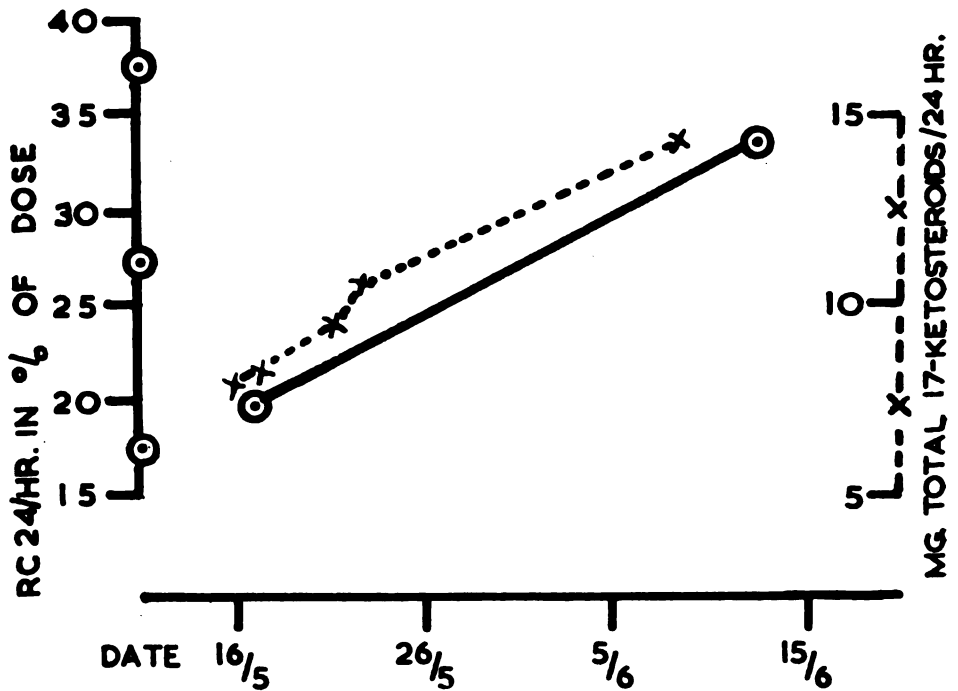


Fig. 1. Hebephrenic schizophrenic—the reduced thyroid activity and 17-ketosteroid excretion rate return to normal with the spontaneous recovery of mental symptoms.

#### Case 1—Schizophrenia-hebephrenic

A young soldier, aged 18, with three months' service, who was admitted to hospital on 17th May, 1955, because of gross disturbance of behaviour. His mother suffered from "nerves" and his father from psoriasis. Patient was an only child with no previous history of instability. He had a good school record.

He first reported sick a few weeks prior to admission with "black-outs" following vaccination. He again reported sick about ten days prior to admission following a T.A.B. injection. He complained of the sun's rays impinging on his body, bullets going through him from guns in the pages of a comic, voices on the radio giving him detailed instructions. He also believed that he was able to control people many miles away by projection of his thoughts.

On admission he was a pleasant co-operative person who was tense and agitated. There was a marked flattening of affect and tangential irrelevance of speech. He showed marked auditory hallucinations, delusions and ideas of reference, with impaired orientation and no insight. The Rorshach test supported the clinical diagnosis. Malamud test score was 21.

*Endocrinological Investigations.* This patient showed a reduced thyroid activity—the 24-hour uptake as measured by the Ring Count was 20 per cent. and two months later was 33 per cent. The total 17-ketosteroid excretion rate

was in the lower normal range and after this it slowly began to rise, but within the normal range (Fig. 1).

His condition showed very little change for two weeks and then gradually a spontaneous improvement began. His delusions became less marked and he soon fully appreciated that he had been mentally ill. He developed fair insight and expressed a certain anxiety regarding his illness. He gradually improved and became rational, coherent and fully co-operative. His Malamud test score prior to discharge was zero. He was quite fit to return to his unit, but had to be discharged because of premature advice given to the parents before investigations were started.

### Case 2.—*Hysterical reaction in a psychopathic personality*

A young officer cadet, aged 19 years, with seven months' service, who was admitted to hospital complaining of suicidal thoughts and feelings of unreality for two months.

He is an only child whose father died following a fall from a cinema balcony. Mother highly strung and had a "nervous" breakdown with anorexia and amaurosis at the time of her husband's death. Patient was separated from mother

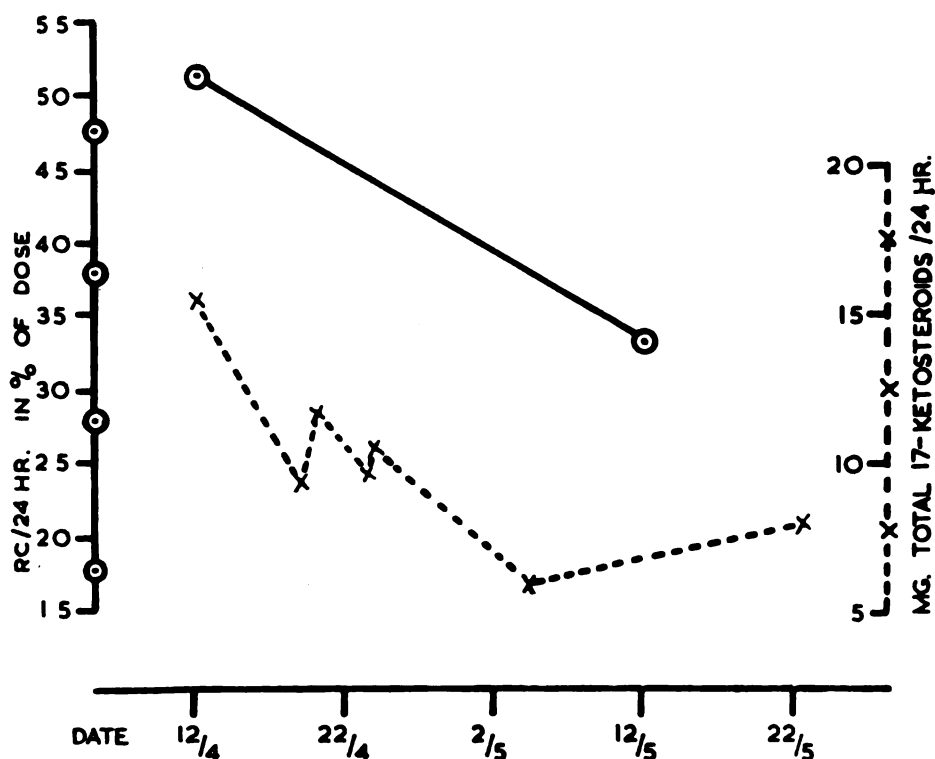


Fig. 2. Hysterical reaction—increased thyroid activity and 17-ketosteroid excretion rate return to normal with spontaneous clinical recovery.



during the war years, from age  $3\frac{1}{2}$  to  $6\frac{1}{2}$ , and brought up by maternal grandmother. His relations with his mother have at all times been strained. Had a public school education, passed a below average general certificate of education, enjoyed wearing flamboyant Edwardian dress. He was a sensitive youth who was easily hurt and if he felt himself slighted would brood and sulk. As a child he suffered from asthma and at 16 years of age was treated by a psychiatrist for "black-out and depression."

On admission he complained that he had difficulty in gathering his thoughts and that someone was interfering with them. He was confused and suspicious, tense and apprehensive. His stream of talk was relevant, rational, logical and coherent, but he was diffident about speaking freely.

Attention and concentration were impaired, orientation in time and place normal. His mood was one of anxiety with suspicious depressive features. He claimed he was hallucinated and deluded. Within 24 hours he declared voluntarily that he had not meant what he had said previously and that he wished to leave hospital.

At first regarded as a doubtful schizophrenia, he was finally considered to be a hysterical psychopath.

*Endocrinological investigations.* On admission the patient showed a slightly increased thyroid activity (R.C.=52 per cent.). One month later the thyroid activity was in the normal range. The total 24-hour excretion rate of 17-ketosteroids was at the time of admission in the upper normal range, and fluctuated within normal limits during his stay in hospital (Fig. 2).

### *Case 3.—Reactive depression*

A 19-year-old soldier with twelve months' service, admitted to hospital on 9th May, 1955, complaining of insomnia, loss of appetite, inability to concentrate and attempted suicide. He was illegitimate and brought up by his mother and step-father. Unhappy childhood, one step-brother, scared of dark. On admission he was an athletic man of good physique who exhibited some tension and agitation. His nails were badly bitten. There was no evidence of thought disorder. His mood was one of mild depression. Average intelligence. He gradually improved without treatment other than physiotherapy.

*Endocrinological investigation.* On admission the patient showed an increased  $^{131}\text{I}$  turn-over ("k"=4.2;  $\text{I}_t$ =10.0), but three weeks later a normal thyroid activity was shown ("k"=1.5;  $\text{I}_t$ =2.8). His 24-hour urinary excretion rate of 17-ketosteroids was normal.

He was discharged to duty on 3rd June, 1955, after three weeks in hospital and is still serving.

### *Comment*

When surveying the experience of psychiatrists into spontaneous recovery from various forms of mental illness it becomes obvious how little is known about the physiological mechanisms involved in such changes. Their elucidation should help not only towards a better understanding of the pathogenesis of mental

illness, but from a practical point of view should enable the psychiatrist to predict occasionally a spontaneous remission. In this connection studies of endocrine changes during spontaneous recovery are valuable and should become more so as laboratory tests become more precise. Furthermore, such information might better indicate the place of deep insulin coma and electroplexy which have such far-reaching influence on the metabolism of the body and can interfere with spontaneous recovery.

The change from their normal civilian environment to service conditions of initial training and later unit training leads in some young soldiers to mental break-down. Many improve spontaneously in hospital and the possibility of this should always be looked for. Reliable objective criteria in the form of endocrine changes would help greatly in the final disposal of the patient.

Experience indicates that many of these young soldiers can be returned to duty and do not break down again, while others may have to be readmitted some months later. It is interesting, however, that in the latter their mental condition is frequently not so severe as the initial illness, while endocrine deviations are not so marked. The significance of these findings requires further study and is being pursued.

#### GROUP C

*Patients with endocrinological disturbances whose hormonal imbalance was not apparently influenced by routine care and attention in hospital.*

Some 22 patients comprised this group under the following diagnoses:

Schizophrenia ...	...	...	...	10
Anxiety state ...	...	...	...	7
Immature personality	...	...	...	3
Homosexual ...	...	...	...	1
Hysteria ...	...	...	...	1

In this group where there was clear evidence of disturbed hormone equilibrium, attempts were made to normalize this disturbance in order to assess the effects thereof on the patients' mental state.

The following case notes illustrate some of the findings.

#### *Case 4.—Acute anxiety state with phobic features*

A young unmarried regular senior N.C.O., aged 24 years, with three years' service, complained of weakness, palpitations, hot and cold feelings, unaccountable panic attacks and pains in the head. He had lost confidence in his capacity to do his work and felt acutely tense and anxious in the presence of superiors. These symptoms had been present for six months. He was treated in hospital in Germany for three weeks with modified insulin therapy in December, 1954, and discharged fit to his unit. Within a week his symptoms returned more acutely than before, necessitating his readmission to hospital and final transfer to the Royal Victoria Hospital, to which he was admitted on 19th January, 1955.

Examination revealed a tidy, neat, clean-shaven, flabby youth with pale face, of high intelligence, who was tense, anxious and agitated and very restless.

He spoke rapidly and precisely, but showed no disturbance of thought processes. He exhibited some acne vulgaris on face, neck and shoulders ; tremor of his fingers and sweating of the hands and feet. His extremities were cold. B.P.140/85.

Due to parental friction, he had an unsettled though happy childhood. His sister is in a mental defective colony. His maternal grandmother died in a mental hospital.

*Endocrinological investigations.* The most significant changes observed in this patient were a total 17-ketosteroid excretion rate above normal range.

The 24-hour <sup>131</sup>I uptake of the thyroid of this patient was, at the initial time of measurement, within the normal range, but the summit of <sup>131</sup>I uptake was reached some hours before, as indicated by the steep uptake rate "k" in the first hour, resulting in an "It" above the normal.

The endocrine deviation seemed to indicate an over-activity of the pituitary anterior lobe, and on this assumption it was decided to try the effect of treatment aimed at suppressing this activity. Accordingly the patient was given 5 mgm. Oestradiol Benzoate (Dimenformin) daily. Five days after commencing treatment the thyroid activity and the total 17-ketosteroid excretion were reduced to normal range. At the same time the patient assured his doctors that subjectively he felt much better. Objectively there was marked clinical improvement, which continued to such a degree that he was sent back to his unit fit for duty. His clinical progress and endocrinological findings during his period in hospital are shown in Fig. 3.

#### *Clinical progress during treatment*

- (1) 26.1.55 Malamud Rating Scale 19.
- (2) 8.2.55 E.E.G. and X-ray skull revealed no abnormality. Clinical condition remains unchanged.
- (3) 13.2.55 Exhibits some obsessional ruminative traits and objectively little improvement.
- (4) 25.2.55 Subjective improvement marked. He states that he feels much happier and contented. Concentration better. Still sweats on hands and feet. Sleeping well.
- (5) 2.3.55 Clinical improvement continues. Is much more cheerful and optimistic.
- (6) 8.3.55 Appears anxious. Feels he is relapsing and had a brief panic attack. Readily accepts that he has not relapsed but that his earlier improvement following injections was more apparent than real.
- (7) 13.3.55 Clinically he is well and cheerful, contented and keeps himself occupied in occupational therapy and assists in the ward work.
- (8) 20.3.55 Clinical improvement maintained.
- (9) 22.3.55 Malamud Rating Scale 8.
- (10) 23.3.55 Discharged to unit in Category S.7—for review in three months.

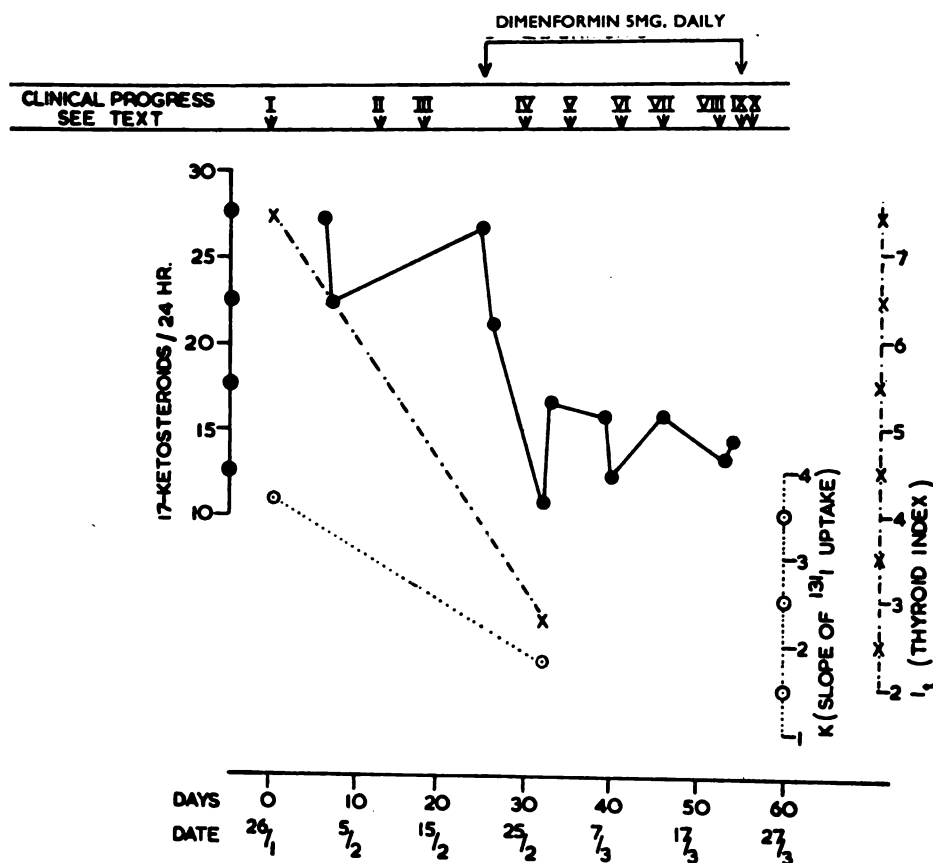


Fig. 3. Acute anxiety state with phobic features—reduction of high 17-ketosteroid excretion rate and thyroid over-function using dimenformin associated with recovery of mental symptoms.

### Comment

The severe tension and panic attacks failed to respond to modified insulin and psychotherapy. When admitted to the hospital a vicious circle had apparently developed with emotional tension, accompanied by pituitary over-activity with increased production of thyrotrophic and corticotrophic hormone, resulting in increased activity of the thyroid and adrenal cortex. The increased amount of hormones released by these glands appear to have been related to the persistence of the patient's symptoms. He is still serving satisfactorily.

### Case 5.—Acute anxiety state with compulsive features and impotence

A junior N.C.O. of 20 years, married, above average intelligence, with six months' army service, was admitted to the Royal Victoria Hospital, Netley, on 14th September, 1954, with severe acute anxiety features. On examination the patient was very tense, anxious and agitated. He walked with a slow hesitant step, and when asked to sit down placed himself on the front edge of the chair,

where he kept fidgeting, wringing his hands and biting his nails. He appeared unhappy, suspicious and frightened. He exhibited marked tremor of the lips and hands. He spoke in a dull, monotonous, soft and petulant voice and was clearly most reluctant to discuss his problems. His talk, however, was rational, relevant, logical and coherent. There was no evidence of disordered thinking. His mood was one of misery and self-pity and throughout the interview he was in tears. Mood and thought content were congruous. There was no evidence or ideas of reference or influence, hallucinations or delusions. He was well orientated in time and place. His hands were moist, but no other physical signs were elicited.

In addition, he complained of compulsive urges to wear women's clothing and of impotence with his wife. The former had been present since the age of six years, when he used to sleep in his parents' bedroom and put on either his mother's or his sister's underwear. This urge, to which he had succumbed, had occurred two or three times a week ever since. He got married six months prior to admission to a girl who knew about his compulsion. Since then he has frequently dressed up in his wife's underclothes.

On all these occasions he would wear the garments for about 15 minutes, frequently having an erection, but denying any ejaculations. The wearing of these garments relieved his emotional tension, but he became harassed by thoughts that he would like to become a woman. He complained that his marriage was in danger of breaking up because of his sexual relations with his wife, which were hopeless, and he had had no proper sexual intercourse since marriage.

He had a satisfactory school and employment record and until he reported sick he had an excellent service record.

*Endocrinological investigations.* This patient showed an increased thyroid activity as determined by the tracer method, while his 17-ketosteroid excretion rate was slightly above normal. These findings suggested an increased activity of the pituitary anterior lobe. Consequently in order to depress this activity the patient was treated with long-acting Oestradiol Undecylate (Oestradiol Depot, Schering) injected intramuscularly. Following this the thyroid activity gradually came down to the normal range and the total 17-ketosteroid excretion rate also fell. The endocrine findings and clinical progress are illustrated in Fig. 4.

#### *Clinical progress during treatment*

- (1) 23.9.54 No clinical change. Malamud Rating Scale 20½.
- (2) 1.10.54 Patient still tense.
- (3) 4.10.54 Anxious, agitated, sleeping badly, poor appetite. Weepy and querulous. Malamud Rating Scale 19½.
- (4) 15.10.54 Clinical condition unchanged.
- (5) 20.10.54 Patient happier. Sleeping and eating well. Some tension still present, absence of tearfulness.

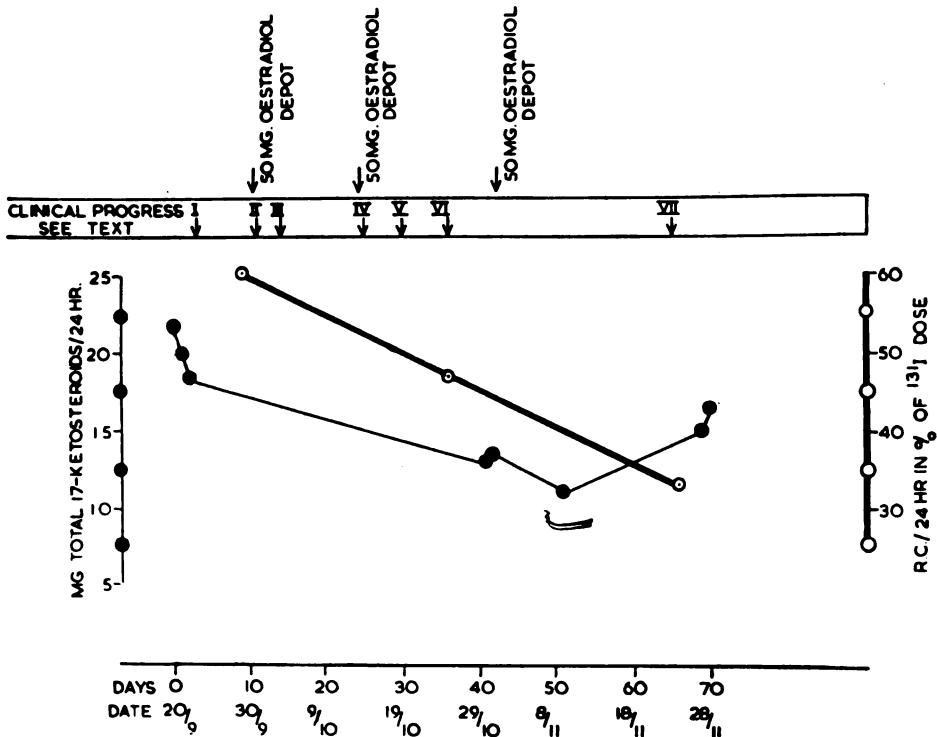


Fig. 4. Anxiety state with convulsive features—restoration of hormone-equilibrium with dimenformin associated with recovery of mental symptoms.

- (6) 26.10.54 Marked improvement. Patient is happy. Sits calmly without tension and states that his sexual relationships with his wife have been perfect during the week-end.
- (7) 29.11.54 Discharged to full duty. Malamud Rating Scale 2.
- (8) 1.6.55 Continuous serving with no symptoms.

#### Comment

Suppression of the pituitary activity of this patient with Oestradiol Undecylate (Oestradiol-Depot Schering) restored the hormone equilibrium.

Oestrogen is a recognized cause of impotence and is extensively used in the suppression of sex drive in those who are heterosexually over-zealous and in homosexuals. This is the first recorded case in which oestrogen has been used as a therapeutic agent in a patient complaining of impotence. The careful dosage of oestrogen did not affect the patient's sex drive, but it did seem to play a major part in relieving his neurotic symptoms. The latter were not improved with routine hospital care and daily intensive psychotherapy, prior to treatment with Oestradiol Undecylate. This long-acting preparation is of value in patients in whom daily injections produce additional stress which might delay the establish-

ment of hormone equilibrium. He had three injections each of 50 mg. while in hospital. In this case mental improvement accompanied the normalizing of the hormone equilibrium. In order to maintain the latter it was arranged, on discharge from hospital, to give the patient one injection of Oestradiol Depot (50 mg.) every eight weeks. He has been regularly reviewed and a recent assessment of the patient shows that improvement has been maintained and he is no longer impotent.

*Case 7.—Catatonic schizophrenia*

A young National Service man, aged 24 years, who was admitted to hospital in December, 1954, after two days' army service. He was an only son. His parents observed that nine months prior to joining the army he had become quieter, more asocial, with little interest in his surroundings, and finally had to give up work. He was treated at his home for neurasthenia by his family doctor. Family history irrelevant.

On admission he was mute, negativistic and inaccessible. He sat still, staring vacantly into space, and exhibited *flexibilitas cerea* in his limbs. After investigation and observation he was given a course of electroplexy (E.C.T.) and insulin coma therapy. Neither produced any improvement in the patient, who had in all 12 E.C.T. and 30 insulin comas.

*Endocrinological investigations.* As there was no apparent improvement with these conservative methods of treatment it was felt that other lines of investigation should be carried out. Accordingly about a month after completion of E.C.T. and insulin treatment, endocrinological investigations were done. The latter revealed thyroid activity, using the tracer method, to be well below the normal range, while the total 17-ketosteroids fluctuated daily. He was accordingly given thyroid in gradually increasing doses until he was on 10 grs. daily. On the fifth week of treatment his pulse rate began to swing between 70 and 100 per minute and thyroid was reduced to 5 grs. daily. There was, however, little improvement in his mental condition and one modified electroplexy was given. This produced a very severe mental reaction with outbursts of aggression and rambling incoherent speech which lasted for several days. He gradually became more chronic and his condition remains the same. He was transferred to a civilian mental hospital near his home at his parents' request.

*Comment*

This case illustrates the giving of thyroid extract to a patient on the basis of marked thyroid hypofunction and its failure to produce any clinical improvement.

*Case 8.—Acute anxiety state in a schizoid personality*

A young soldier, aged 20 years, with 18 months' service, was admitted to hospital in Germany on 2nd April, 1954, following a suicidal attempt by swallowing aspirin, and transferred to Royal Victoria Hospital, Netley, on 16th June, 1954.



On admission he was very anxious, agitated and tense and exhibited facial twitching and sweating of the palms of the hands. His stream of talk was relevant and rational with some circumstantiality and tendency to verbosity and vagueness. Concentration was impaired. Memory intact. Mood mildly depressed but no incongruity. Well orientated. No hallucinations or delusions. Physically nothing abnormal detected.

From early childhood he showed emotional instability and behaviour disorder, necessitating frequent changes of school and outpatient psychiatric treatment.

Mother was a chronic alcoholic in a mental hospital who eventually committed suicide. His only sibling, a young brother, was for years under care of Child Guidance Clinic.

#### Comment

This patient was given deep sedation in July which failed to improve his clinical condition. He later developed pneumonia, following which he exhibited temporary improvement. Later he became so acutely tense and agitated that Chlorpromazine hydrochloride (Largactil) was given. This produced no clinical improvement and as his white blood cell count showed an alarming drop the drug was stopped. Finally, it was decided to investigate his thyroid and adrenal function to see if this would help in providing a clue as to treatment. Following these investigations a rationale of treatment was established, after which the patient showed a steady improvement. This case illustrates the importance of distinguishing between primary and secondary thyroid hyperactivity.

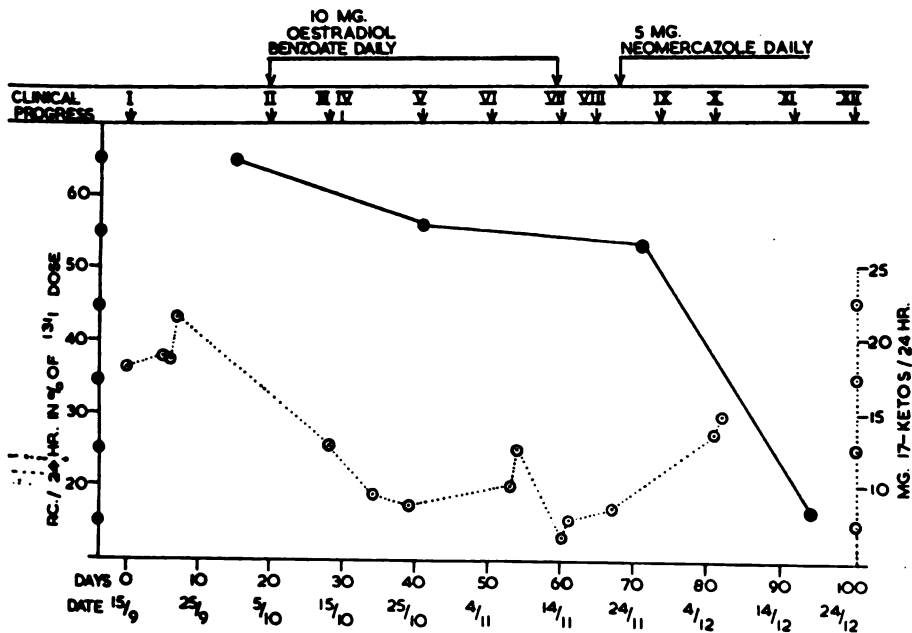


Fig. 5. Anxiety state in schizoid personality—not until reduction of thyroid activity with neomercazole did clinical improvement occur.

**Endocrine investigation.** The predominant disturbance in the hormone equilibrium of this patient was a considerably increased thyroid activity, the ketosteroid excretion rate being in the upper borderline of the normal range. On the basis of these findings the patient was treated with Oestradiol Benzoate 10 mg. daily in order to reduce the predominant thyroid activity considered to be secondary to pituitary hyperfunction. However, the thyroid activity was little affected, remaining high in spite of this treatment. The 24-hour daily urinary excretion rate was reduced, but there was no evidence of any clinical change. It was therefore argued that the increased thyroid activity in this case was a primary hyperfunction of the thyroid itself and accordingly Neomercazole treatment was started, after which the thyroid activity was reduced, and the excretion rate of 17-ketosteroids remained within the normal range (Fig. 5).

**Clinical progress.** His clinical progress following endocrinological investigations and therapy based on these findings is shown in Fig. 5.

- (1) 14.9.54 Extremely tense, nervous and distressed. Difficulty in expressing himself.
- (2) 4.10.54 Patient is restless and agitated. Exhibits some twitching of the face, tremors, lips and fingers. Acne on face. Emotionally labile and wept at interview. Some flattening of affect. Insomnia, Malamud Rating Scale  $21\frac{1}{2}$ .
- (3) 9.10.54 No clinical change. Restless sleeper.
- (4) 12.10.54 Appears happier. Subjectively feels much better. Objectively there is little difference.
- (5) 26.10.54 Subjectively and objectively improved. Not agitated or restless. No tremors. Sleeping better.
- 29.10.54 Improvement continues. Malamud Rating Scale 14.
- 2.11.54 Returned from leave. Very restless and agitated. Had an emotional outburst at home yesterday when threw a cup of tea at wall after argument with his step-mother.
- (6) 5.11.54 Little improvement. Remains restless, agitated and emotionally labile. Malamud Rating Scale 24.
- (7) 12.11.54 Clinical condition unchanged. An impulsive outburst of bad temper in which he threw a plate at the wall.
- (8) 19.11.54 No clinical improvement. Very nervous and tense. Continually puts his hand to his mouth when talking.
- (9) 26.11.54 Clinical condition remains unchanged.
- (10) 5.12.54 Appears less agitated and tense. Still remains asocial. Concentration still impaired.

- (11) 18.12.54 Objectively shows clinical improvement. Less anxious. Optimistic about his future and most sociable.
- (12) 23.12.54 Discharged hospital. Much improved.

He has been regularly reviewed since and continues well on a maintenance dose of 5 mg. Neomercazole weekly.

### CONCLUSIONS

This paper has indicated some preliminary endocrinological investigations in acute psychiatric patients admitted to the Royal Victoria Hospital, Netley. It shows that with existing methods for investigating hormone dysfunction there are some acute psychiatric disorders in which there are no associated endocrine disturbances; in others such disturbances are present but transient, normal hormonal equilibrium is restored without specific treatment, and is frequently accompanied by a corresponding recovery in the mental symptoms and signs.

Others with definite endocrine disturbances which continued under hospital care and management were treated on the basis of the endocrinological findings with varying success.

In some cases empirical methods of treatment produced no clinical improvement and where endocrine deviations from the normal were found, a rationale of treatment was based on these findings. Where the latter restored the hormone equilibrium there was frequently a corresponding improvement in the mental condition of the patient. Without this treatment it is doubtful whether these patients could have been returned to duty.

It is, of course, too early and the cases are too few to claim that any permanent results will accrue from this rationale of treatment. Further observations in this direction are required and a longer follow-up of cases is needed.

Studies of schizophrenics have been so far inconclusive, but it would seem worth while to continue researches on these lines. This should be useful, especially in early and fairly recent acute cases. Such researches should provide factual information, either negative or positive, regarding the relation of endocrines and the mental state for the various sub-types of this syndrome.

It is not very common to find classical endogenous depression in military patients in the age group described. It has therefore not been possible to confirm or otherwise the work of Reiss *et al.* (1949) and Bryson & Martin, (1954).

Studies of urinary excretion of 17-ketosteroids, if interpreted correctly, should throw light on the state of the adrenal cortex in mental disease. The introduction of chromatography in assessing the fractions of the 17-ketosteroids will further advance our knowledge. In the papers already referred to there is evidence that changes do occur in these fractions in mental illness, the significance of which is at present not understood.

The facts obtained lead to the conclusion that these investigations are worth doing. Even if hormones are in the end proved to be of value in the treatment of

some mental disorders it will never be possible to say how many patients with any particular syndrome are cured, but only the percentage of those exhibiting endocrinological deviations who were cured by normalizing the latter.

I should like to thank Dr. M. Reiss, Director of the Biochemical and Endocrinological Research Laboratories at Bristol, and his staff for laboratory tests and interpretations; also Q.M.S. S. C. McGinnes, R.A.M.C., for thyroid tracer tests.

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## EXERCISE "ROYAL ROAD"

D.G.A.M.S. ANNUAL EXERCISE, 1955

BY

Major-General F. M. RICHARDSON, D.S.O., O.B.E., M.D.

THE editor has given me the privilege of adding this account to those of the series of exercises which I have reported in this Journal. In "Mushroom" (6), "Rubicon" (7), "Cambyes" (8) and "Avernus" (9), as Inspector of Training, I had a leading part to play, and I could not escape entirely this time, as anyone who heard the D.G. sum up his first three exercises may guess. He used to say that he had hardly moved into the D.G.'s office before I was at him about an exercise ; and he came to expect me to say in the week after the exercise, "About your next year's exercise, sir . . ." The first key plan produced last November suggested "Alamein in reverse" as a study of breaching operations, supported by an amphibious assault or by an airborne landing ; and, when I saw from the programme that both of these supporting operations were to be dealt with, I felt like a small boy at the end-of-term feast—delighted by the rich and varied menu, but doubtful of our ability to absorb, let alone to digest, it all. But the rationale of the diet prescribed was soon apparent. Since November, 1954, the proposed new organization of our field medical services—the "New Look" as the D.G. called it—had been conceived, and it was his purpose to examine its application to various military operations. So first a brief word about this "New Look."

Previous exercises seemed to have given inescapable indications that our present system lacks the flexibility which nuclear warfare demands ; particularly because it is based upon a requirement which may be becoming out of date—*i.e.*, to collect casualties in forward areas and to transport them to the rear for surgical treatment. In the very likely event of casualties falling most heavily on rearward areas we have virtually no facilities there for collecting them, although arrangements for hospital treatment are excellent. In the divisional area, on the other hand, everything is geared for efficient collection, and facilities for holding and treating casualties are, intentionally, very meagre. Perhaps it is even out of date to speak of forward and rear areas. So far as the risk of casualties is concerned, nuclear warfare may abolish this distinction. Perhaps we should think in terms of what I have called the "two-way flow" conception of treatment in the field. Suppose that, as a result of atomic attacks on the communications zone, our C.C.S.s and general hospitals are in chaos and filled with casualties from these attacks. Night is falling, and for the battle about to begin a standard plan involving the evacuation of divisional casualties into this chaos is clearly impracticable. It cannot be too strongly emphasized that *this* is the nightmare threat which is forcing us to examine the provision of facilities for holding and treating casualties within divisions, and *not* only the much less frightening possibility that, in the dispersed battlefield of the future formations may get cut off or their evacuation routes interrupted. If the divisions themselves sustain

heavy casualties from nuclear attack, various difficulties in collection and evacuation might well create a need for some method of bringing treatment to the scene of the disaster. For all our arguments in the past, we have yet to find a tidy method of earmarking a suitable medical reserve, without which our plans to meet nuclear attack cannot really be flexible. These are some of the reasons for the proposal to provide the collecting and treatment potential in the form of two units—a "medical collecting unit" and a "medical staging unit" (M.C.U. and M.S.U.) taking the place of field ambulances, field dressing stations, and field medical companies; adjusting the balance of our medical manpower throughout an operational theatre; and in their administrative H.Qs. providing nuclei upon which might be built up collecting and treatment elements in the required mixture to cope with changing situations. During "Avernus" after a description of a F.D.S. acting as "filter" to a C.C.S., Colonel Crosse made the pertinent comment that there must be something wrong with a unit which could not function without the help of another unit. Of course, the "filter" was needed particularly when two or more C.C.S.s could be located together in a corps medical centre; but none the less the Army Medical Directorate have felt that the C.C.S. is not ideally constituted, and hence have proposed a third new unit—the "Evacuation Hospital."

In explaining his object in the exercise the D.G. emphasized that the proposed new units were one possible solution to our grave problems, and were put forward as a basis for discussion. The exercise theatre of operations in which they were to be tried out was the Middle East—and above the stage hung a fine map of that area on which electric indicators lit up when required during the various serials. We were urged to imagine ourselves to be actually there, in 1960, and helped to do so by the occasional appearance of Egyptian waiters and *fellahin*, and a lovely pantomime camel. Veterans of "Cambyeses," however, noted the absence of Jouv from the map, and of genuine camel dung, which in 1953 was purloined for us from Chessington zoo by Captain W. O'Brecht, R.C.A.M.C. Perhaps the usual threatened coal shortage prevented the reckless expenditure of this useful fuel.

Colonel Meneces, in a brilliant example of those polished performances which we have come to expect of him, gave us the exercise setting, perfectly blending a warm feeling for ancient history with a cold appreciation of the hard facts of the future. He told us that the Royal Road from which the exercise took its title was that between the valleys of the Nile and the Euphrates, which for over five thousand years has been followed by so many conquering armies—Assyrian, Babylonian, Egyptian, Greek, Roman, Jewish, Arab, Turkish, French and British. Those who served in the Lebanon will remember how many of these conquerors left their commemorative tablets at the Dog river crossing.

Colonel John Crosse, as D.M.S., 81 Army Group, General Careful, had his usual heavy task of expounding the medical plan for the whole theatre, which he did with his customary lucidity, and I could have simply referred you to my accounts of his fine performances in '52, '53 and '54 had he not designed the absolutely perfect climax for his serial. Having sketched in a portrait of his

devoted but rather truculent and difficult airborne A.D.M.S., he gave "Alastair" a ring, and asked him to drop in for a talk, and was almost immediately enveloped in a cloud of dust, and was seen struggling on the floor to escape from a parachute whilst his airborne A.D.M.S., who had dropped through the roof, did his best to brush and soothe him down.

The plan to break through the Alamein Line from our Libyan base in order to drive the Fantasians out of Egypt gave Lieut.-Colonel Marks, as A.D.M.S., of one of the assaulting divisions, a chance to discuss, in a conference with his D.A.D.M.S. and the C.Os. of his M.C.U. and M.S.U., how these proposed new units could best support a breaching operation. This playlet was preceded by a talk by Lieut.-Colonel Marks about breaching operations, and followed by one about minefields by Colonel F. M. Hill, R.E., who then staged a minefield demonstration, which ended with the whole audience having to walk to the tea tent through a miniature minefield which gave us a practical demonstration of the average chance of getting through unscathed. The first of the miniature explosions was touched off by a senior officer who took a lot of convincing that the D.G. had not personally flung a missile at him. This was amusing, but I am sure that during the demonstration, in which the feelings of a young M.O. faced with having to do something for the victims of a minefield disaster were most vividly portrayed, no one who had ever had the remotest connection with minefields could have failed to be slightly stirred by that feeling of cold fear which mines must bring to most normal men.

When teaching our soldiers about the residual radio-activity following a low-burst atomic missile, we should not forget that in war caution must sometimes be tempered by resolution. I remember a unit which had been very well trained, including much practice in taking cover. In their first serious action they did little else. Even in the presence of a high rate of radio-active contamination it may be possible to enter an area, move about in it for a time, and come out without getting more than a dose so small as to be acceptable as a legitimate war-time hazard in saving life. I wonder if the thought of what the radiations were doing to one's bone-marrow whilst one took that risk might not be less chilling than the expectation as one went agaging through a minefield, that one might soon have no legs to have any marrow in. The first day ended with a talk, "The prisoner of war in Fantasian hands," by Brigadier Robinson, the Director of Army Psychiatry, followed by a play on this subject which he had written himself; the two constituting a serious study of an important problem which has lately been very much to the fore.

Some well-known members of the "Mytchett Repertory Company" appeared in the play. Captain Alan Critchley, who has delighted audiences in Paris as well as Mytchett with his playing of Fantasian generals, appeared as a particularly loathsome specimen; and our old comic Irishman standby, Staff Sergeant O'Sullivan, surprised his fans by turning on some tragedy for a change. What I described in my account of "Avernus" as the "warm transatlantic voice" of Captain Matt Cooper this time had to take on what I suppose a dramatic critic might call the ragged edge of hysteria, and did it very well. But who was the



impressive bearded figure in the kalpak, or whatever Fantasians do wear ? Being the sort of mug who forgets to look at the programme till the lights are out, I was foxed and really thought it was one of those bright members of the R.A.D.A. whom from time to time we have imported from the Depot to help with our plays. But it was Brigadier Robinson again, not only a playwright, but a new-comer to the "Mytchett Rep"—along with two other successful new actors, Corporal Staples and Private Stewart.

The effect of these two serials was rather depressing, the dominant note being that everyone has his breaking-point. As we had reached the end of a very long day there was no time to discuss the prevention of break-down, which was in fact dealt with in "Cambyes." Obviously anything which helps the soldier to withstand the growing nervous strain of modern war may help him to stand up to "brainwashing" and so on, even perhaps when influenced by drugs. The soldier does not fight for abstractions like "Democracy," but for his home and family, and perhaps even more for the good name of his unit, especially of his own small group within it, his platoon—his own immediate military family, as it were. Fear of disgrace, fear of the contempt of his comrades, may help to steel his heart, but it is better if his resolution and self-control should stem from confidence in his comrades, as well as in his own military ability, and from determination not to let either down. This loyalty to the small group may be even more important than the wider loyalty to the unit—*esprit de corps*. By both of these loyalties the man's personal instincts of self-preservation, which would counsel him to run away, are balanced by herd instincts directed to a common resolution to overcome danger and fear for the good of the unit. When "the colonel's dead and the Gatling's jammed," the soldier will think more of his platoon than of the Blankshire Regiment, the Union Jack, or the United Nations. When he is a prisoner he will still be a member of a group, probably a different one, but one which by companionship in adversity might become an even more devoted one. One of the most interesting facts in reports from Korea is that some prisoners who were professed Communists, and had been so before their captivity, refused to become informers and to betray their fellow-prisoners. Presumably they gave to Communism an allegiance transcending their allegiance to their country, but their loyalty to their comrades transcended even that. If it is true that under hypnosis a man cannot be made to commit actions which conflict with his higher principles, it seems possible that "brainwashing" techniques, even the use of drugs, may have difficulty in breaking a man sustained by this cardinal military virtue of loyalty to his comrades. It was our purpose in "Cambyes," as described in pages 76 to 84 of the report (11), to examine how by facing up to the dangers of break-down under the nervous strain of war and preparing for them by mental training, a man's resistance to it could be raised, as can his resistance to bodily fatigue by physical training. We did not specifically mention enemy methods of interrogation, but much of what was said in "Cambyes" has a direct bearing on that difficult problem, which Brigadier Robinson so powerfully impressed upon us in "Royal Road."

On Saturday morning we had a very comprehensive survey of airborne

operations compressed into three hours, beginning with a lecture by Lieut.-Colonel Alastair Young, who also described the medical plan for the airborne attack on Fayid. We then went to the Aldershot District Sports Fields for a demonstration by 16 Independent Parachute Brigade Group, which included a section of a parachute field ambulance jumping from a balloon at some 500 feet to land about 50 yards from the audience, and setting up a C.C.P. where they later demonstrated their equipment. We were very lucky that close to Mytchett was stationed this fine brigade, with its field ambulance, Lieut.-Colonel Young's old unit, now commanded by Lieut.-Colonel John Kilgour. The whole airborne interlude was boldly conceived, meticulously planned, and faultlessly executed—as an airborne operation must be. I have called it an interlude because, as the D.G. said, the "New Look" is not applicable to airborne divisions.

For the rest of Saturday we were involved in the aftermath of an atom bomb explosion on Benghazi, a most interesting presentation based on an exercise run in Fayid by General Drummond when he was D.M.S., M.E.L.F. Before lunch in a series of playlets we heard first of the plans made by D.D.M.S., Communications Zone, for dealing with atomic casualties, and then after an atomic strike near Benghazi we watched the reactions of the C.O. of a 1,200-bedded General Hospital there, and learned how the time between the explosion and the expected arrival of the casualties was to be used in preparation for their reception. After lunch we saw a demonstration of how these arrangements might work, going first to where, near the scene of the incident, the O.C. of 5 M.C.U. was co-ordinating with a Provost officer and the O.C. of a M.A.C. the plans for collecting and sorting the casualties, the urgent ones being sent to the General Hospital, and the less urgent ones being admitted to a "Casualty Filtering Post" established near at hand by two companies of the M.C.U. Here a mobile bath unit had set up a cleansing station for casualties, including stretcher cases, in need of decontamination. At the hospital we were shown the organization for admission, assessment, resuscitation, and post-operative treatment of mass casualties; and also some details of the sterile supply system, the blood bank, and some of the wards. All of these aspects of the work of a general hospital were demonstrated by members of the medical and nursing staff of the Cambridge Hospital, and it was obvious at every turn what a tremendous lot of careful planning and hard work everyone must have put into making this splendid demonstration so interesting and instructive, and even moving, for they really managed to convey a sense of the human element in such a disaster. Their C.O., Colonel Drew, told me that though the staging of this demonstration had certainly involved much hard work, they had all enjoyed it and it had been a powerful stimulus to their training and morale.

Colonel Drew, rather to the surprise of his friends, who had never before seen him invested in the motley of Drury Lane in place of that of Harley Street, was the star turn of the playlets. How we all sighed at first that so attractive a matron should be wasted on such a doddering old re-tread! But as the action developed we saw that he was on top of his job, and we had to endorse the verdict of two wars, that there is good stuff in these retired officers still. General Drummond,

who had organized this part of the exercise, himself appeared in the opening playlet as D.D.M.S., Communications Zone ; and we were glad to see General Careful dealing with his rather turbulent subordinate with all the aplomb acquired during experience as the D.M.S. of various Army Groups since 1952, albeit for only three days per annum. Perhaps he was helped by the fact that the real general was concealed behind an almost impenetrable thicket of black moustache. The Directing Staff, or perhaps it was only Captain Critchley, evidently thought that paragraph 1015 of the Queen's Regulations would have been repealed by 1960. Major-General Careful could have referred to his officers as his "old moustaches" with as much justification as Napoleon, but perhaps with less envy, as he was himself notably hairy-faced, whereas Napoleon seems to have had a rather smooth face. I suppose that this could have been associated with the tendency to dystrophia adiposo-genitalis, from which Raoul Brice, a French surgeon lieutenant-general, has deduced that he suffered (1). An English Army surgeon's (4) eyewitness account of the post-mortem examination of Napoleon, quite apart from making short work of the rumour of cancer,\* makes interesting reading, especially some details delicately camouflaged in Latin which, together with some reasonable deductions from certain aspects of his conduct, suggest the origin of those aggressive impulses which created Napoleon from Napoleone Buonaparte.

Anyway he was lucky if he was spared the tendency to "five o'clock shadow" which caused Wellington to shave sometimes as often as three times a day—and that with those rather inadequate-looking implements which one can see in Apsley House. It was enough to make anyone a bit testy, and this provides me with my own pet theory as to how it came to be believed that Wellington was unsympathetic to the medical services. That exactly the reverse was in fact the case is clearly shown in the autobiography of Sir James McGrigor (5), which is pervaded by evidence of a sympathetic and helpful Commander-in-Chief. But of course quarrels and disagreements do make more interesting reading, and tend to be remembered in gossip when the details of harmonious co-operation have been forgotten. So most of us have heard of that stupendous rocket which Sir James received, and indeed deserved, for he had been evacuating his casualties by a route other than the main administrative axis, and using transport which Wellington had earmarked for operational use ; and it is well known how terribly starved of transport that army was. Wellington was in a rage, and began, "I shall be glad to know who is to command the army, you or I." I have said that he had good cause for anger, but hardly for rage, which was common with Napoleon, but most uncommon with the Duke. And it seems to have been a proper rage, for the third person present in the room was so scared that he abruptly quitted it, and here is the point, for that third person was Goya, to whom Wellington was at the time sitting for his portrait. Could the Duke have already noted that this portrait, like some others, a Lawrence for example, was

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\* Brice, who says that "Napoleon was always in a state of chronic indigestion," believes that at St. Helena he had an amœbic liver abscess, ending in perforation into the stomach, a gastric perforation, and peritonitis.

beginning to show that blue chin about which he must have been sensitive ?—for even a reputation for neatness, which gave him his nickname of “the beau,” hardly demands three shaves a day in the field. Of course there are good reasons, and less speculative ones, to be found for the few occasions when he could not agree with his medical adviser’s ideas, and often Wellington gave these in detail himself. Even when planning the battle of Vittoria he found time to write a long two-page letter to explain why he could not comply with some of Sir James’s requests.

After this rather irrelevant cadenza on the theme of General Drummond’s moustache I would just get back to business by saying that “Bombs on Benghazi” contained lessons of great importance for us all, whether concerned with civilian or military practice, and, whilst each detail of it may not be appropriate to every situation, the précis in the official report of the exercise will be an invaluable blue-print for any scheme for dealing with mass casualties from the disasters of peace or war. The only previous contribution to this post-war series of D.G.’s exercises which I would personally rate as more important is the big demonstration during “Mushroom,” which I would put first because of its impact on the army as a whole. It must have been the first attempt on such a scale to demonstrate protection of troops against atomic weapons, because the D.G.M.T., General Sir Richard Gale, who saw it, ordered us to repeat it twice for senior officers ; and later, when Commander-in-Chief of Northern Army Group, he sent one of his officers to Mytchett to export the demonstration to Germany. Abridged versions have been given several times every year to the Staff College and other audiences, including members of civilian organizations ; but when we were finally asked to enact it for a training film in 1954 we felt that the time had come for the army to teach this protection itself. “Bombs on Benghazi” was purely medical, and this time it was General Dimond of the Ministry of Health who said that it should be filmed ; so perhaps, after all, it should be put equal first.

On Sunday morning, the last day of the exercise, the cloth-model desert had become the Mediterranean Sea, on which the varied craft needed to put ashore one brigade in an amphibious operation were to be seen approaching the beaches near Haifa, on which a landing was to be made in support of our successful advance into Egypt, which by drawing off most of the Fantasian troops stationed in Israel had made such an operation a worth-while risk. Great sea-borne assaults on the scale of our Normandy landings may now be impossible because of the threat of atomic attack, and it was well that we should be reminded how considerable a fleet of shipping is needed for only one brigade. It was too easy to imagine the effect of the underwater bursts of even one or two nominal bombs, with their base surge and all, on the operation which we were watching. During Colonel Ahern’s description of the mounting of an amphibious operation I thought of his many powerful performances in ’51 and ’52. I would not like to imply that my mind wandered, for he spoke with all the clarity to be expected of a former C.O. of the Field Training School ; but I will admit that I did just find time to recall a small Scots schoolboy’s definition of a “beach.” Having

defined an island as a piece of land entirely surrounded by water, and a lake as a piece of water entirely surrounded by land, he said that a beach was "a wee dog entirely surrounded by ither wee dogs." In the demonstration following Colonel Ahern's talk a DUKW was demonstrated by Major Thomson of the School of Amphibious Warfare, who even told us why it is spelt like that ; and we then saw the sort of set-up which an M.C.U. and M.S.U. might establish ashore in support of a landing. Lieut.-Colonel Graeme Warrack looked in vain for a storm-boat in which to attack his speed record of 1952, and it was just as well that there was not such an assortment of craft as we assembled for "Rubicon," because after the drought Mytchett Lake barely provided flotation for a decorous DUKW-load of generals, escorting Dame Helen Gillespie.

Demonstrations of amphibious operations without sailors rather lack glamour. Inter-service co-operation, the keynote of success, is nowadays taken for granted, but it was not always so good, as Sergeant Robertson and some of his comrades of the 92nd found whilst they were making good their escape from Corunna (10). Even when they had reached the transport, after jumping from a height of twelve feet into the last boat just as it was pushing off from the shore, their troubles were not over, for when the French shelled them with two field pieces "the sailors not having been accustomed to that sort of work would not come on deck to work the vessels, but left the management of them to the soldiers who could not be supposed to be very proficient in nautical affairs." It seems that considerable chaos and loss of vessels resulted. But usually, far from letting the soldiers do their work, the sailors loved to dash ashore, cutlass in hand to try a bit of land fighting ; like those who at Walcheren "pursued the enemy a considerable distance, and considerably annoyed them." (2). From other accounts of that wretched campaign\* I think that the sailors referred to in that account were a party commanded by Captain Charles Richardson of *Cæsar*, who are said to have "made themselves conspicuously useful" (3). It was, of course, in a similar foray that Nelson at Calvi† acquired the blind eye which was traditionally so useful at Copenhagen. The management of all the shipping needed for a modern assault, and the organization of maintenance over beaches, once they have surmounted the difficulties of getting us ashore, keep the navy busy enough these days, and they have to confine their wonderful tricks with dismantled guns to swinging them over imaginary ravines in the Royal Tournament. The navy was represented at "Royal Road" by Surgeon Captain C. B. Nicholson, attending his third D.G.'s exercise, and, as he feared it might be his last, he said some nice

\* When the navy brought home the Walcheren survivors it was the second time in eight months that they had had to do this for a powerful British Expeditionary Force. No wonder there was a tremendous public outcry and a Parliamentary inquiry. Readers of this Journal know what a part was played in this disaster by malaria, but may not have heard of the rather ridiculous bawdy note on which the House brought to an end some six days of debate and over twenty of inquiry by the Committee of the Whole House. Sir Home Popham was explaining why some ships had not gone where they were intended to go, but had had to put in to that part of the East Scheldt called the Roompot. The report ends : "'unexpected circumstances compelled the transports to go to the Roompot' (Here an universal laughter drowned the voice of the Hon. Member, and as soon as it had subsided, strangers were ordered to withdraw.)"

† It was on account of this action that he applied to the Secretary at War for the allowances of a Brigadier-General in the army, with results of which no soldier will be in any doubt.

things about us from which we learned that his feelings for his army colleagues are considerably warmer than the faintly amused tolerance which we sometimes suspect the senior service reserves for the "pongoes." The D.G. was particularly struck by his apt comparison of the possibility of assembling the required companies of M.C.U.s and M.S.U.s to give a formation the collecting and treatment facilities which a particular operation seems to require, with the manner of forming naval squadrons to meet any particular task. This brought a dreamy look into the eyes of the Inspector of Training, Brigadier Franklin, who, unlike Sergeant Robertson's highlanders, is "very proficient in nautical affairs." In the last serial of the exercise, which was a report on A.E.R. and T.A. training, a less pleasing comparison was suggested by Colonel Meneces, who called these units a "meccano set." For this act of apostasy on the part of a member of the Directing Staff, he said himself that he was expecting that his next appointment would be A.D.M.S. Rockall; and he has since sent me the following establishment:

ROCKALL (MEDICAL ESTABLISHMENT)

A.D.M.S.....	1
Clerical Assistant (mermaid).....	2
Gannets (general duty).....	3
Albatross.....	2

Although it would be a lonely life, he should at least be assured of frequent visits by the Inspector of Training.

Each year the D.G. has said that his exercise has simply got to be the best yet, and I felt, especially during the Saturday's demonstrations, that he had certainly pulled it off this time. Looking back over the six D.G.'s exercises which I have attended, I realize that each had its high-lights. Embedded in the official reports, like currants in a cake, are lectures and précis of discussions from which we have much to learn. Some examples are two valuable lectures in 1954, on "Burns" by Mr. Patrick Clarkson, and on "Resuscitation" by Colonel Stephen, and Sir Arthur Porritt's lecture in "Horatius," 1950—a lantern to light the military surgeon's path, and one which, despite the passage of five years, needs no trimming of the wick, as Sir Arthur Porritt himself recently assured me. These accounts of mine in the *Journal* are intended only to whet your appetites for the full reports.

"Royal Road" followed logically after "Avernus," for it was the picture painted in "Avernus" and sketched in on the first page of this article which made some reorganization on the lines of the "New Look" inevitable. Enjoying the irresponsibility of Opposition after four exercises on the Government front bench, I pointed out some of the flaws in the proposed new organization, which we in Germany think we detected during our autumn manœuvres. I was supported on the Opposition front bench by Colonel P. J. Richards, and from a back bench by Colonel Leslie Keatinge, in his most avuncular elder statesman vein. This is not the place in which to develop these arguments, but it may be said that our exercises seemed to prove the validity of some of the claims made for the new units. Lord Wellington once said, "It is impossible to command a British

Army," and we found that we had to echo his cry in relation to the M.C.U., which in its present form we found impossible to command and control. But if anyone should feel tempted, and it is terribly tempting to all who have loved the field ambulance, which includes anyone who has ever commanded one, to say "Let's leave well alone, and rely on the units which have served us so well in two great wars," let him study again the "Avernus" picture of the possible shape of the battlefield of the future. Let him also remember that Sir Richard Gale has said, "The side which enters the next war with the mentality of the last will suffer from a disadvantage from which it might not recover." Another good motto for us is the saying of Scharnhorst, quoted by Herr Blank, the West German Defence Minister, when swearing-in officers and men of the new German armed forces : "It must be the tradition of an army to stand at the head of progress."

It is deceptively easy for those who are concerned principally with divisional and corps problems to say that the divisional area is no place in which to hold the casualties who in a modern army should surely be promptly sent by air to the proper place for surgery. But if that "Avernus" nightmare is a fair prophetic glimpse of the future battlefield, and the best authorities have not yet dared to say that it is not, there may be nowhere to send those casualties to, whether you have a squadron of helicopters, or a fleet of flying carpets operated by Michael and all angels. And we must also remember that without collecting facilities in rearward areas, that shambles which is embarrassing our medical plan for clearing our A.D.S.s cannot be tidied up quickly. That is why we may have to tighten our belts and see how big a slice of our divisional cake we can give up to redress the balance.

There was so much ground to cover this year that the time available for discussion was only about half that of last year, but the D.G. indicated that discussions of these crucially important matters will be continuing actively in the following months, during study periods ; and by a War Office working party—a term which even after three years at the War Office still obstinately brings immediately to my mind a picture of old ladies taking their knitting to the vicarage. A M.C.U. is to be formed under the command of Lieut.-Colonel Marks. Let's hope that, just as Wellington did, he may after all discover the secret of how to command it. And finally no doubt from all this should surely result some workable scheme for us to try in future manœuvres.

A rather tiresome innovation this year was the use during discussions of a portable microphone. The speaker, pregnant with some great thought, indicated that the time had come for it to be delivered to the world ; but when one of the very efficient team of young soldiers handed him a sort of electric razor on a long cable, the effect, rather like being handed a deaf old lady's ear trumpet, was to paralyse thought, so that he could think of nothing to say but "Hallo." It might have been as well if some of us had said just that, and sat down. But only those who have had to record and subsequently make a précis of the discussions in past exercises will know the real value of this device. I noticed that one of the helpers, called up for his A.E.R. annual training, was Corporal Clarke, who used

to be one of those recorders who sometimes produced for us the most astounding remarks which speakers were alleged to have made. Last year, during a surgical discussion in which Lieut.-Colonel Stephen was being questioned, the D.G. prefaced a last question by saying, "Before we leave Bob alone . . ." This was typed out as "Before we leave for Boulogne . . ." We were often forced to put what we thought an intelligent speaker ought to have said. Perhaps it was not such a bad method after all.

The outdoor demonstrations, except for the airborne and minefield ones, were run by the A.E.R. wing of the Field Training Centre, and it was clear that they had learned a lot since last year, for things went with a swing worthy of their Field Training School wing, veterans of so many successful shows. I doubt if many of the audience realized that the vast majority of these actors were young reservists who had not been available for as much as a week of rehearsal—an indication of the hard work and careful organization which must have been needed to achieve such good results.

The unusually large number of nine American officers attended the exercise, and in addition to our old friend Brigadier-General Wilford Hall they included Major-General H. G. Armstrong, United States Air Force in Europe, and Major-General S. B. Hays, who had succeeded another General Armstrong as Surgeon General to the United States Army. General Hays gave the D.G. his only anxious moments of the exercise, when he went up in the balloon at the airborne demonstration and was said to be intending to jump out with a parachute. During the evening following this demonstration the Field Training Centre workshops made a special memento which was presented to the General next day to mark the occasion of his being the only general officer of the United States armed forces, so far as our records showed, to make a balloon ascent during a D.G.'s exercise. Thanking the D.G. for this memento, General Hays referred to a remark he had made on the first day of the exercise when the pantomime camel presented to him an address of welcome. He had then said that he wondered if he was intended to draw any conclusions from the well-known fact that this animal could go a long time between drinks. Now on the last day of the exercise he said, "How was I to know that the animal had diabetes?" I wonder if the general could have brought the house down with this sally if he had had to signal for a nursing orderly to bring him the microphone first. Mr. Gadsby of the Army Operational Research Group, a very regular attender at our exercises, was with us again, and Australia, Canada, India, and Pakistan were also represented.

After the D.G. had thanked those who had helped to make the exercise a success, Brigadier Roy Ward, D.D.M.S., Anti-aircraft Command, thanked the D.G. himself for all the enjoyment given to so many by his four exercises, and for the greatly increased opportunities for medical officers of the A.E.R. and T.A. to attend them. Though Brigadier Ward was the spokesman for the medical officers of the Reserve Army, he perfectly expressed what we were all feeling. We have all enjoyed these exercises and it is no secret that the D.G. has enjoyed them enormously himself. Not the least reason for this enjoyment has been the



chance of getting together with our colleagues from the whole army. There are many factors which make it difficult for us to train the National Service man as well as we would like to do during his time with the Active Army, and in many cases defects in his education remain to be filled in by the Reserve Army. In the early days it was not uncommon to hear complaints by Territorial officers that the Regular Army, with all its facilities, was leaving too much of its work to be done by devoted volunteers during the man's part-time service. Contacts during training, and above all this annual gathering of a representative cross-section of the senior officers of both Active and Reserve Armies, have enabled us to understand one another's problems and to iron out many possible sources of friction ; and have welded us into one medical service. Having been Inspector of Training during three of the years of this process, I was in a good position to know how sincerely Brigadier Ward was expressing the feelings of Reserve Army officers, and to echo his sentiments from personal experience.

Now it is much less easy to praise someone who, as they say, is "still with us" than it is to write an obituary notice, when the victim is beyond the power of answering back, whilst the wildest statements are condoned by those who may know better, under the "*de mortuis*" rule. You all know the sort of thing I mean. "His single-minded absorption in his profession left him little leisure for outside interests or social contacts, but those who were fortunate enough to gain the sparingly awarded prize of his friendship recognized that his gruff and almost forbidding manner overlay a character of sterling worth." This may be freely translated as "I've done my best for the old so-and-so but you all know he was a dull, crabbed old bore with no friends." Try that sort of thing on the guest of honour in an after-dinner speech and you must surely be a bit cramped by the uneasy feeling that he is saying under his breath, "Silly ass ought to know me better." But I could have seconded Brigadier Ward's charming speech with no such uneasy feelings, for I am sure that the D.G. had forgotten that almost his last official act as D.M.S., M.E.L.F., was to launch in my direction a jet-propelled rocket with atomic warhead. I know that he had forgotten because his bite is worse than his bark—which is surely better than the other way round. After all, in the army one expects to be bitten now and then, but barking, which I think of as synonymous with nagging, for when does a bark become a yap?—barking is not an endearing habit. Give me the bite every time, preferably a bite free from Negri bodies and quickly healing. To those who wonder how I, of all people, survived three War Office years unbitten, the answer is that the training for war of our regular and reserve medical units is not only a matter in which the D.G. naturally took a tremendous interest, but one which, with its relatively straightforward problems, must have often been in welcome contrast to the intricate and worrying affairs, some of them affecting the future of our Corps as we know it, with which we all know he had to deal. When these weighty affairs kept him chained to his desk in the summer stuffiness of London he occasionally greeted my sun-tanned return from some lovely week amongst the camping and manœuvring A.E.R. and T.A. with "Had a good leave?" ; which made it a bit tricky to ask when I could expect to get a little leave. But he could always

find time to ask all about our doings in the training field, and as I said last year, "he was always ready to escape from the cares of his high office for a frolic with the Fantasians." Until the lessons to be brought out at the exercise and the methods by which these were to be taught and demonstrated had been clearly defined there were no frolics, but once such details were settled the D.G. himself led the revels.

In recent correspondence in the Press about the training of circus animals those who denied that any cruelty was involved pointed out that animals trained by cruel methods could not give the happy sort of performance which the public expects. As at Olympia, so at Mytchett.

And now many of our present D.G.'s troupe of performing seals have flipped their tubs for the last time, and, to the dying strains of their motor horns, will soon gambol off into the seven seas. There are as good seals in the sea as ever came out of it, and you may be sure that D.G.'s exercises will go on traditionally—each one better than the last. But, speaking for my fellow seals, we will always be proud to have been associated with four first-class performances (when were circus folk ever modest?), and we are giving the stories of them to our proprietor, with whom we stood "at the head of progress," as a tribute of our affectionate regard, and in gratitude for all we learned and all the fun we had whilst preparing and staging Exercises "Rubicon," "Cambyzes," "Avernus" and "Royal Road."

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# THE INCIDENCE OF OSTEOCHONDRITIS DISSECANS

BY

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THE purpose of this paper is to establish the incidence of osteochondritis dissecans in the age group in which it is known to occur most commonly. In the services, the majority of men are aged 18-30 years and thereby constitute this age group. The total number of men reporting sick, whose signs and symptoms required a radiograph of a particular joint, were taken as the index for comparison. Four joints were considered, namely the elbow, knee, ankle and hip. The total number of such men covered by this report was 18,405, of whom 427 suffered from osteochondritis dissecans, *i.e.*, 2.3 per cent. This paper is an analysis of these 427 cases which were seen over an eight-year period at one military hospital.

## *Review of the literature*

The literature on osteochondritis dissecans was reviewed very fully by Mensor & Melody (1941), whose work dealt mainly with the occurrence of this disease in the ankle joint. Ray & Coughlin (1947) reviewed the literature from 1941 onwards and added a further 14 cases of osteochondritis dissecans occurring in the ankle joint. They discussed the ætiology and concluded that trauma was the primary cause.

Kleinberg (1949) reported a case of bilateral osteochondritis dissecans of the patella. Hay (1950) reported two cases in whom several joints were affected and came to the conclusion that neither injury, congenital anomaly nor constitutional disturbance played any part in the ætiology of this disease. Simpson (1950) recorded a further case occurring in the ankle joint. Roberts & Hughes (1950) published an extensive review of the whole subject and quoted one case with several joints involved. With reference to ætiology, they concluded that both a constitutional factor and a local factor played a part. Van Demark (1952) recorded a series of cases in children where spontaneous healing occurred through revascularization of the separated fragment. Marks (1952) reported a case in which a flake fracture was said to have progressed to osteochondritis dissecans.

Green & Banks (1953) discussed the incidence of osteochondritis dissecans in children between the ages of 4 to 15 years, the natural history of the disease and their results of treatment. They also noted the fairly high incidence of other types of osteochondritis in the cases which they treated. Coltart (1952) and Nisbet (1954) described a dome fracture of the talus and regard this as a different entity from osteochondritis dissecans.

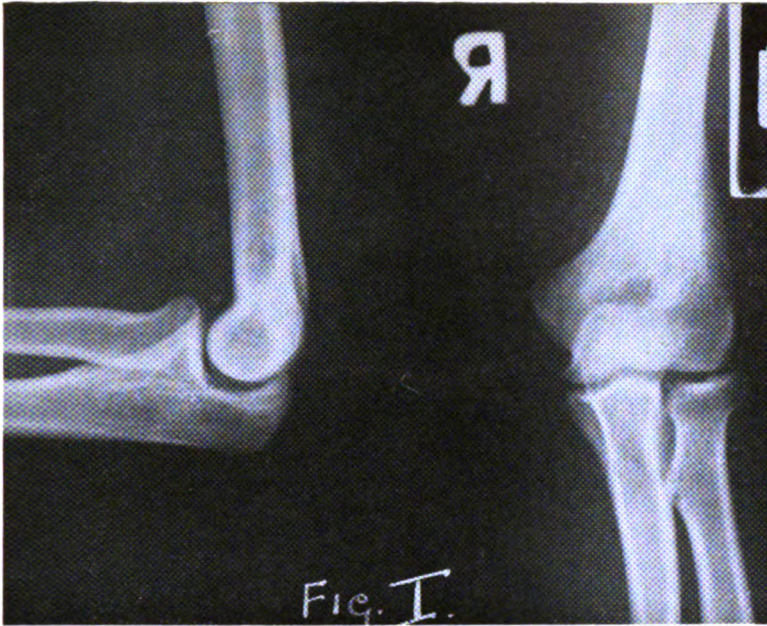


Fig. 1. O.D. Head of radius.



Fig. 2. O.D. of patella.





Fig. 3. O.D. Right hip.

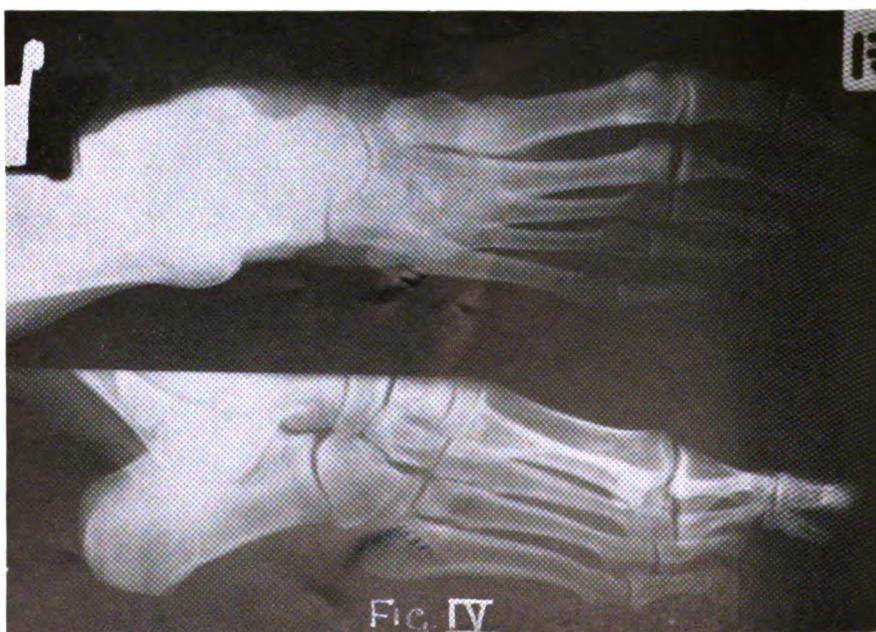


Fig. 4. O.D. Head of 2nd metatarsal.

### *The ætiology and diagnosis of osteochondritis dissecans*

This disease has been attributed to one or more ætiologies. Ray & Coughlin (1947) thought that trauma was the underlying factor, yet others, such as Nisbet (1954), look upon the result of trauma as a fracture and not as osteochondritis dissecans. In soldiers a history of some type of trauma can be obtained in practically every case, ranging from stamping of feet on the parade ground to major injuries such as are experienced in time of war, and therefore such a history cannot be interpreted as being necessarily the ætiology of the disease.

The diagnosis of osteochondritis dissecans is made on the radiographic appearances, and hence in establishing the incidence of this syndrome it has to be taken into account that the interpretation of the radiographs plays a large part in the number of cases diagnosed.

When considering the natural history of the disease, as described by Green & Banks (1953), it is to be noted that in early cases the only change to be seen is one of localized subchondral decalcification which in a certain number of cases progresses no farther and recalcification takes place. If this is taken as the criterion for the diagnosis of osteochondritis dissecans, then the incidence is far greater than if only the formation of a separate fragment is recognized as a necessary finding before the diagnosis is made. We have accepted, for the diagnosis, evidence ranging from definite localized subchondral decalcification to a chondral or osteochondral loose body or an osteochondral defect in the bone.

### *The incidence of osteochondritis dissecans in the elbow*

Table 1 shows that the incidence of the disease is greater in the right elbow than in the left, which is a similar finding to that of Roberts & Hughes (1950). In determining the actual site of the osteochondritic bed some considerable difficulty may be found due to the secondary changes taking place in the part of the joint opposite to the lesion. The capitellum appears flattened when it is the site of an osteochondritic lesion, whereas in Fig. 1 the deformity is similar, but due to a lesion in the head of the radius, which has also produced the typical enlargement of the head.

From Table 2 it can be seen that the incidence of osteochondritis dissecans in the elbow is 3.6 per cent. The total number of cases comprises all those cases whose clinical signs and symptoms required a radiograph of the elbow joint.

### *The incidence of osteochondritis dissecans in the knee*

The findings of previous authors are confirmed in that the incidence in the medial femoral condyle is, on an average, three times that of the lateral femoral condyle, there being no significant difference between right and left. This is shown in Table 3. Osteochondritis dissecans of the patella (Fig. 2) was seen in only seven cases. In eight cases a femoral condyle in both knee joints was affected (Fig. 5).

Flattening of the medial femoral condyle, similar to that of the capitellum, is seen in the antero-posterior view of the radiograph (Fig. 5) and should arouse suspicion of an osteochondritic lesion. A notch view may be required to demonstrate the site.

The incidence of osteochondritis dissecans in the knee joint is 4 per cent. when the total number of cases in comparison is taken as all those having clinical signs and symptoms which required a radiograph of the joint (Table 4).

*The incidence of osteochondritis dissecans in the ankle*

In assessing the incidence of osteochondritis dissecans in the ankle joint no distinction between this diagnosis and that of dome fracture of the talus was made. It is interesting to note that, in the vast majority of cases in this series, the lesion occurred on the supero-medial articular angle of the talus, which is a similar finding to that of Ray & Coughlin (1947), whereas the cases described by Nisbet (1954) as fractures all occurred on the supero-lateral angle (Fig. 6, Table 5).

The incidence of osteochondritis dissecans of the ankle joint is 0.5 per cent. of those patients whose signs and symptoms required radiography of the ankle (Table 6).

Table 1. *Analysis of incidence of osteochondritis dissecans in the elbow joint, 1947-1954.*

	Total	Left	Right	Bilateral
Humerus	33	31	1	
Radius	16	22	1	
	4	8	—	

Table 2. *Incidence of osteochondritis dissecans relative to the total number of cases seen, 1947-1954, in the elbow joint.*

Number of joints affected by O.D.	Total number of cases	Percentage of O.D.
86	2,383	3.6

Table 3. *Analysis of incidence of osteochondritis dissecans in the knee joint, 1947-1954.*

	Total	Left	Right	Bilateral
Femoral Condyles	143	148	8	
Medial	73	70	5	
Lateral	19	27	—	
Patella	5	2	—	

Table 4. *Incidence of osteochondritis dissecans relative to the total number of cases seen, 1947-1954, in the knee joint.*

Number of joints affected by O.D.	Total number of cases	Percentage of O.D.
297	7,280	4

Table 5. *Analysis of incidence of osteochondritis dissecans in the ankle joint, 1947-1954.*

	Left	Right	Bilateral
Total	14	21	—
Supero-medial	7	12	—
Supero-lateral	3	3	—

Table 6. *Incidence of osteochondritis dissecans relative to the total number of cases seen, 1947-1954, in the ankle joint.*

Number of joints affected by O.D.	Total number of cases	Percentage of O.D.
35	7,039	0.5



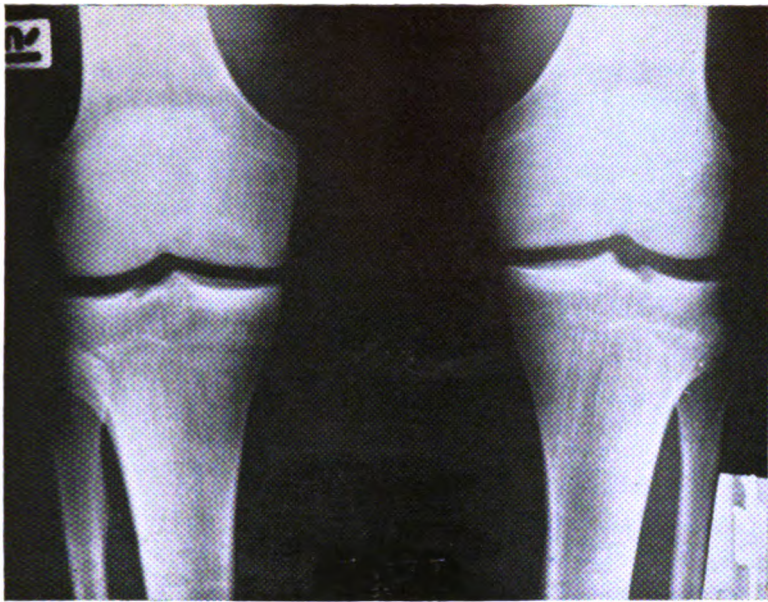


Fig. 5. O.D. Medial femoral condyle with flattening seen in A.P. bilateral.

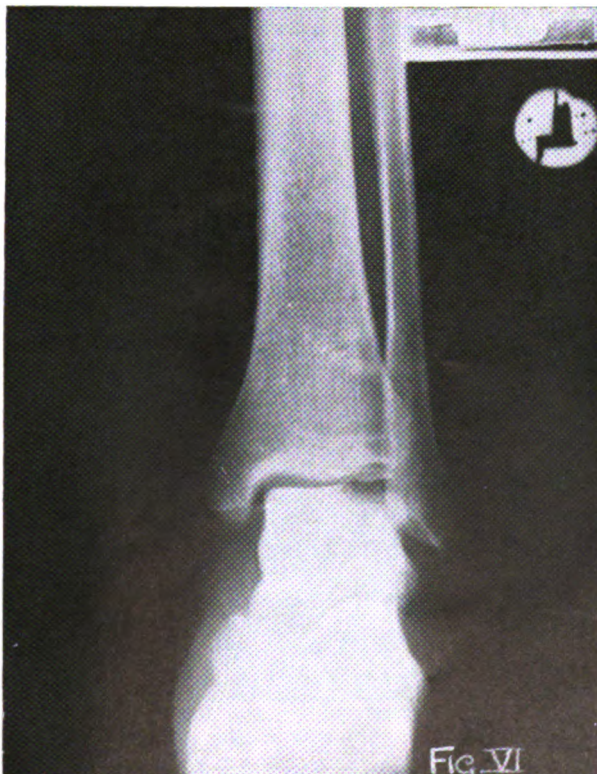


Fig. 6. O.D. Supero-lateral angle articular surface body of talus.



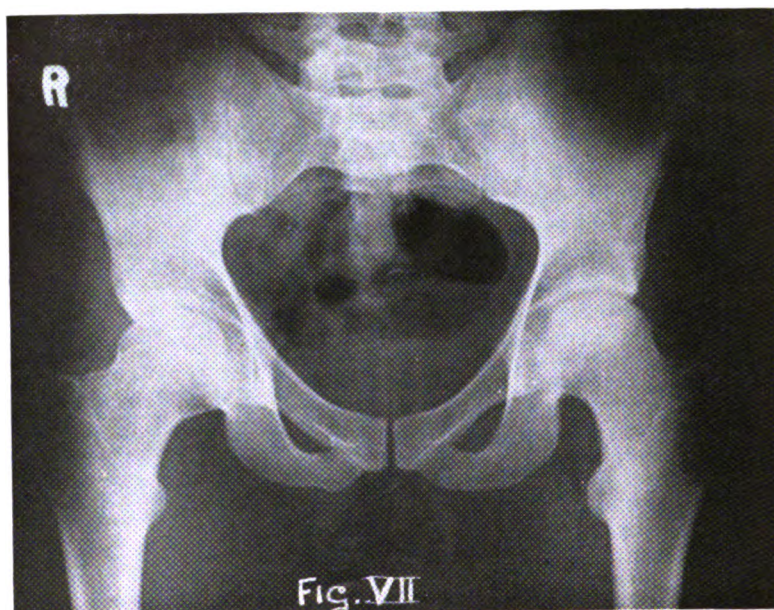


Fig. 7. O.D. Left hip. Clinically irritable hip. January, 1954.

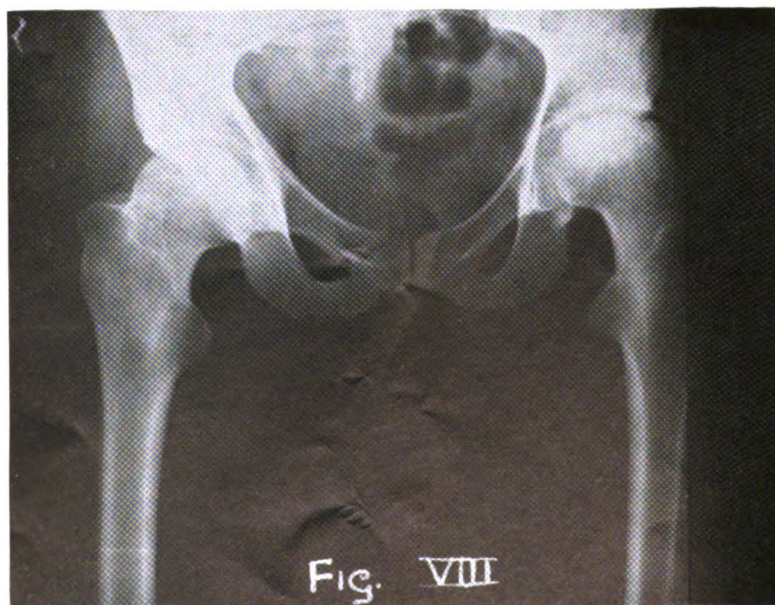


Fig. 8. O.D. Left hip. Clinically irritable hip again. October, 1954.

Table 7. *Analysis of incidence of osteochondritis dissecans in the hip joint, 1947-1954.*

Total	Left 5	Right 4	Bilateral 3
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Table 8. *Incidence of osteochondritis dissecans relative to the total number of cases seen, 1947-1954, in the hip joint.*

Number of joints affected by O.D. 9	Total number of cases 1,703	Percentage of O.D. 0.5
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*The incidence of osteochondritis dissecans in the hip*

The hip is the most interesting joint in which the syndrome of osteochondritis dissecans occurs, as it is the only joint where another type of osteochondritis is seen in the same anatomical position, namely osteochondritis juvenalis.

Osteochondritis juvenalis commences in the majority of cases between the ages of 5 to 10 years ; it is, therefore, noteworthy that Green & Banks (1953), who reviewed this age group, found no case of osteochondritis dissecans, whereas in the present series, in which an age group of 18 to 30 years is reviewed, there were nine instances of this disease occurring in the hip joint (Fig. 3). It is of great interest that the disease in the hip joint was bilateral in three of the six patients, which is a far greater incidence of bilateral disease than in any other joint (Table 7).

The incidence of osteochondritis dissecans in the hip was 0.5 per cent. when calculated in a similar manner to that described for the elbow (Table 8).

*The incidence of osteochondritis dissecans in other joints*

The occurrence of osteochondritis dissecans in the shoulder joint is mentioned in the literature, but no cases were seen during the eight-year period under review.

It is possible that osteochondritis of the head of the second metatarsal is part of the syndrome of osteochondritis dissecans, as frequently a typical loose body is found. Unfortunately, the records are insufficient to include this joint in the present series. Fig. 4 shows such a case with loose body formation. The changes in the contour of the metatarsal head and the base of the proximal phalanx are regarded as secondary in nature, similar to the secondary changes in the bones noted in both the elbow and knee joints.

*The clinical signs and symptoms and their treatment*

The cardinal symptom of which the patients with osteochondritis dissecans complained was pain, and secondly, the effects of irritation of the joint, such as synovial effusion and instability. In both the elbow and knee joints locking episodes are common, and in these joints arthrotomy for removal of the loose body will relieve this symptom, but the pain and instability tend to be unaffected.

In the ankle joint, on the other hand, because of the mechanical structure of this joint, the separated fragment usually remains in the osteochondritic bed and so locking incidents do not occur. The main symptom, that of pain, is greatly relieved by removal of the loose body.

In the hip joint, painful limitation of movement in all directions (*i.e.*, an irritable hip) was the presenting symptom in each case. Only one patient complained of instability and none had experienced locking. In all cases treatment has been entirely palliative.

If the osteochondritic lesion does not heal by recalcification or in more advanced cases by revascularization with maintenance of the normal contour of the affected bone, then in the course of time a mechanical osteoarthritis of the joint is set up.

*Case report on osteochondritis dissecans of the elbow*

W. W., aged 21, male, presented with inability to extend the right elbow for the past two weeks. He had had no injury that he could remember. The limitation of extension was due both to pain and to a mechanical block. During the two-week period he had had one day during which the elbow had returned to a normal range of painless movement.

On examination, flexion of elbow was limited to 80 degrees and extension to 160 degrees. He was tender over the head of the radius. Radiography revealed a loose body.

At arthrotomy a cartilagenous loose body, the size of a pea, was removed and the convex edge of the head of the radius was noted to be eroded, but not so deeply as to reveal the underlying bone.

Five weeks after operation flexion of the elbow was full while extension was limited by 10 degrees. All movements were pain free.

*Case report on osteochondritis dissecans of both knees*

W. K. B., aged 20, male, presented with symptoms of recurrent effusion and painful instability of both knees, the right being worse than the left. He had had multiple locking episodes, but there was no definite history of unlocking. Radiographs revealed osteochondritis dissecans of both medial femoral condyles (Fig. 5).

He had an arthrotomy of the right knee in September, 1953, when his medial meniscus was found to be torn and was excised. The osteochondritic bed was scraped out. A similar procedure was carried out on the left knee one week later. The post-operative period was uneventful and he became symptom free.

He remained symptom free till the commencement of severe army training a year later, when pain and effusions into both knee joints recurred. There was, however, no recurrence of locking or instability. His symptoms failed to respond to three months of intensive physiotherapy and it was necessary to invalid him out of the army.

*Case report on osteochondritis dissecans of the ankle*

H. J. C., aged 23, male, when jumping off an obstacle on an assault course in July, 1953, had an inversion plantar flexion injury to his left ankle. This was followed by marked œdema of the whole ankle with bruising and tenderness over the anterior and posterior talo-fibular ligaments. Radiography revealed a







Fig. 9. O.D. Hip. Bilateral.

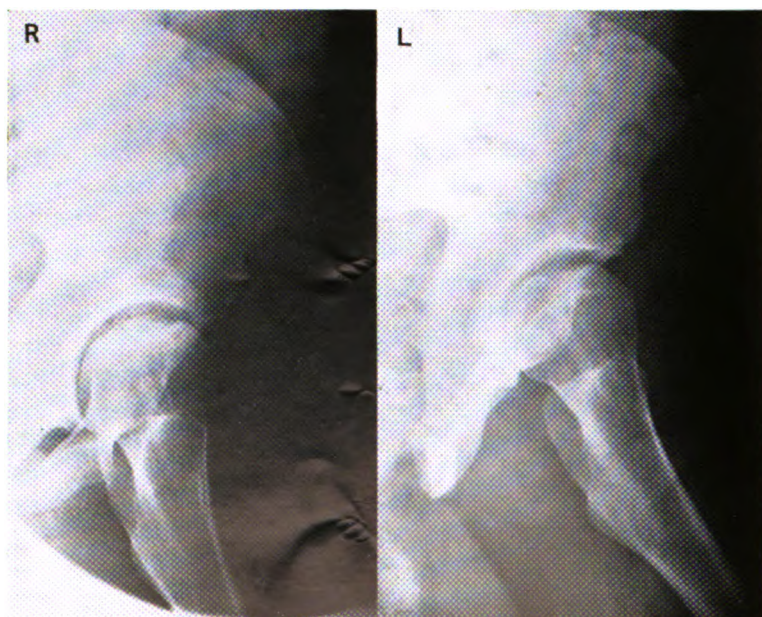


Fig. 10. O.D. Hip. Bilateral. Lateral views.

lesion of the body of the talus towards the supero-lateral articular angle which was diagnosed as an osteochondritis dissecans (Fig. 6).

He was immobilized in a below-knee non-weight-bearing plaster of paris for three months, followed by six weeks in a walking plaster of paris, but despite this, pain persisted and he remained tender over the antero-lateral aspect of his ankle.

Arthrotomy of his left ankle in November, 1953, revealed a loose body still lying the right way up in its osteochondritic bed and not upside down as Nisbet (1954) described it in dome fractures. The loose body was removed and the bed was scraped out.

Following operation the ankle was mobilized at once, and within one month of operation he had full ankle movements and was walking without a limp. The pain had been entirely relieved. He had remained symptom free when reviewed one month later.

#### *Case reports on osteochondritis dissecans of the hip*

Case 1.—J. C., aged 22, male, complained of a gradual onset of pain in the left groin which caused him to limp. This pain, which had been persistent, became more severe in January, 1954. Examination revealed limitation of all movements of the left hip by pain. Radiography of both hips showed no abnormality (Fig. 7). He was immobilized in a double hip spica for six weeks.

On removal of the plaster of paris his radiographs were still said to show no abnormality, and the E.S.R. was normal. He was treated with physiotherapy and became symptom-free, and fit for duty in June, 1954.

Pain and limitation of movements in the left hip recurred in October, 1954, and radiographs then revealed osteochondritis dissecans of the left femoral head (Fig. 8).

He is at present being treated in a Charnley weight-relieving caliper, with improvement of his symptoms.

Case 2.—D. M., aged 18 male, had an injury to his left leg at the age of 14 years. The mechanism of injury was a rotational force on the extended leg. A month following this, pain commenced in the left hip.

Since that time he has had intermittent pain in the left hip. He also complains of instability in the left leg. There have been no locking incidents. Radiographs reveal a well-marked osteochondritis dissecans, with loose body formation on the left and an early osteochondritic lesion on the right (Figs. 9 and 10).

He had had no symptoms in any other joints and a complete radiographic survey showed no other abnormality.

On examination of his left leg he was found to have wasting and diminished tone of the gluteal and quadriceps muscle groups, with a positive Trendelenburg list, and painful limitation of all hip movements.

His symptoms on this occasion had been brought on by the increased activity of basic training in the army. Following admission to hospital and restricted activity he became symptom-free, though there was no change in the physical signs.

## SUMMARY

1. The literature on osteochondritis dissecans is reviewed.
2. The incidence of the disease in service patients whose signs and symptoms required a radiograph of elbow, knee, ankle or hip joints, over an eight-year period, is recorded. This was 3.6 per cent. in the elbow and knee and 0.5 per cent. in the ankle and hip joints, the age group being 18 to 30 years.
3. The diagnostic radiological features of the disease are described.
4. The role of operative treatment in this disease is discussed.
5. A representative case history in each group is recorded.

We wish to thank the Commanding Officer, Cambridge Military Hospital, for making the records available to us, and the Radiologist, Cambridge Military Hospital, for his help and advice.

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## RESUSCITATION IN THE FIELD

BY

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MANY young surgeons, at the beginning of the Second World War, had at their fingertips all the current theories on traumatic shock in laboratory animals. When suddenly confronted with battle casualties they found great difficulty in applying these theories in practice. Guided by senior colleagues, they gradually gained practical knowledge of resuscitation in the hard school of experience at the expense of their patients. When John Derry's aeroplane disintegrated, on exceeding the speed of sound, at Farnborough in 1952, it was, once again, very obvious that many medical officers were quite unable to assess casualties. The following article includes the generally accepted views on resuscitation, in a practical form for everyday use, as a guide for those who may have to assess mass casualties in the future.

In an atomic war the medical services of the nation will be confronted suddenly with large numbers of surgical casualties. These will consist of injuries from high and low velocity missiles, burns, blast and crush injuries from collapsed buildings. Many of the casualties will suffer from multiple injuries caused by varying combinations of these factors. This mixture of lesions is well illustrated by the experience of a corporal in a tank crew. The tank was knocked out of action by an anti-tank shell. The corporal sustained a fracture of his right tibia and fibula just above the ankle joint, but his foot was immovably jammed on the tank floor. When the spare petrol caught fire, he escaped from the burning tank after cutting off his own foot with a jack knife.

One of the main problems will be to recognize, select and treat those casualties who are suffering from traumatic shock and are in need of transfusion. Adequate transfusion should aim at rendering the casualties fit to stand anæsthesia and surgery, which must be regarded as a second period of trauma.

The clinical assessment of traumatic shock in war wounds has been greatly simplified by the observations of Grant & Reeve (1951). No reference will be made in this article to the burn casualty, as this, in itself, is a vast problem.

### LIMB INJURIES

Blood loss and tissue damage are the two most important factors governing the onset and degree of traumatic shock in limb injuries. The total blood volume in an average adult male is about eleven pints, but in a rough clinical assessment, such as is made on the field of battle, it is sufficiently accurate to accept the average as ten pints for simplicity. After the sudden loss of three pints of blood, the blood volume reaches its critical level of 70 per cent. of normal, which

is about seven pints. Nature's defence mechanism then comes to the rescue and the blood pressure collapses in an attempt to stop the bleeding.

A systolic blood pressure of 100 mm. of mercury is thus a very useful rough guide to the amount of blood which has been lost. Other factors being equal, a systolic blood pressure of 100 mm. of mercury, or over, means that less than three pints of blood have been lost, while a systolic blood pressure of under 100 mm. of mercury means that more than three pints of blood have been lost.

Tissue damage is the second important ætiological factor in the production of traumatic shock. This varies directly with the velocity, type and momentum of the missile. Low velocity missiles, such as the bayonet and flying glass, only damage the tissues they actually cut and shock is produced by blood loss only. This was well illustrated at the battle of Sidi Barrani when the 4th Indian Division pursued the retreating Italian Arabs with fixed bayonets. Some of the Arabs had multiple wounds of the buttocks and yet had succeeded in running considerable distances in the interval between receiving the first and last wounds.

High velocity missiles have an explosive effect in passing through the tissues. They create a momentary cavity many times the diameter of the missile. This results in extensive damage at a considerable distance from the missile track. Small vessels are ruptured, causing interstitial hæmorrhage and œdema which provides an ideal site for the growth of bacteria. Much fluid escapes into this damaged tissue to cause swelling. From this area proteolytic break-down products are absorbed and within a few hours their effects appear in the clinical picture.

It is therefore essential in assessing battle casualties to estimate accurately by observation and deduction the amount of tissue damaged. The readiest unit of measurement of volume for this purpose is the human hand, which is just under one pint in volume. Depending on the nature of the wound, the hand may be used open, or closed as a fist.

### WOUND CLASSIFICATION

The following classification of wounds is based on the amount of tissue damage present in the wounds and is a useful means of forecasting the onset of traumatic shock.

Small wounds	...	Less than one hand of tissue damaged.
Moderate wounds		One to less than three hands of tissue damaged.
Large wounds	...	Three to less than five hands of tissue damaged.
Very large wounds		Over five hands of tissue damaged.

When a large artery such as the common femoral is divided, the resulting severe hæmorrhage will bring on traumatic shock rapidly, irrespective of the tissue damage. When no large vessel has been cut it is usually possible to correlate blood loss and tissue damage. A small wound loses one to two pints of blood and a moderate wound two to three pints. With this amount of blood loss the casualty is usually still able to maintain the systolic blood pressure above 100 mm. of mercury, as the blood volume is still above the critical level of 70 per cent. of normal. A large wound loses from three to four pints, whereas a very large

wound loses five to seven pints, which is more than half the total blood in the body. In the latter two types of wounds, the blood volume is below the danger level and the systolic blood pressure drops so that transfusion is required to restore the blood volume.

It is important to stress that large, gaping, incised wounds, although they may look ghastly, do not contain much damaged tissue and do not cause traumatic shock, apart from hæmorrhage due to divided large vessels. With traumatic amputations the damaged tissue in the stump only is measured as the severed limb is discarded. With multiple wounds the wound classification depends on the sum total of damaged tissue in the various wounds.

### *Secondary factors.*

On the field of battle, primary traumatic shock caused by hæmorrhage and tissue damage may be simulated or modified by neurogenic shock due to secondary factors such as anxiety, fear, painful movements, dehydration and morphia poisoning. For example, at a regimental aid post, a soldier with a small wound of his hand which has had only a small hæmorrhage may appear to be at death's door, yet he is not in need of transfusion. The problem that presents itself is how to distinguish quickly those who need transfusion to save their lives from those who need some minor form of resuscitation, such as *sal volatile* and a mug of hot sweet tea. It may seem ridiculous to compare these, but on superficial examination they look exactly the same.

### *Circulatory patterns.*

Four simple circulatory signs can be relied on to make a differential diagnosis :

The systolic blood pressure (normal 100-140 mm. of mercury).

The pulse (normal 70 to 99 beats per minute).

The temperature of the distal extremities (warm or cold).

The colour of the face (pale or rosy).

It is well known that when a soldier after wounding presents the normal pattern of normal blood pressure, normal pulse, warm limbs and rosy lips, he is fit for evacuation and is fit to stand an anæsthetic because his blood volume is near normal.

The four abnormal patterns are not so well known. In each the casualty has cold limbs and pale lips, and they differ only in the blood pressure and pulse as follows :

1. *The cold tachycardia pattern.* Here the blood pressure is normal, the pulse is rapid, the limbs are cold and the lips are pale. The key to this pattern is the normal blood pressure and fast pulse. Since the patient can maintain his blood pressure, this pattern means that his blood volume is above the critical level of 70 per cent. of normal and that his blood loss is less than three pints. In all probability he has a small or moderate sized wound. He can be evacuated safely without transfusion once the hæmorrhage has been controlled. He will need a prophylactic transfusion of about two pints before operation.

2. *The vaso-vagal pattern of neurogenic shock.* Here the blood pressure is low, the pulse is slow, the limbs are cold and the lips are pale. The key to this pattern is the slow pulse. This pattern is due to secondary factors already mentioned, such as anxiety, fear and pain. It is not due to blood loss or tissue damage. The casualty does not need blood transfusion. An excellent form of resuscitation is to lower the head end of the stretcher for five minutes. That should restore the blood pressure to normal. If the blood pressure again falls on restoring the patient to the horizontal, further clinical examination is indicated.

3. *The cold hypotension pattern.* Here the blood pressure is low, the pulse is fast, the limbs are cold and the lips are pale. The key to this pattern is the low blood pressure and the fast pulse. This means that the casualty, through blood loss and tissue damage, can no longer maintain his blood pressure. His blood volume has therefore fallen below the critical level of 70 per cent. of normal and his blood loss is greater than three pints. His tissues are suffering from acute anoxia. Resuscitation is an urgent matter and varies with circumstances. It is best to lower the head end of the stretcher, control all external hæmorrhage and evacuate the casualty towards surgery without delay. He will stand a short, speedy, smooth journey under the influence of morphia, reasonably well. He is in urgent need of rapid transfusion to restore his blood pressure, but this is best delayed until surgery is at hand. The volume transfused should equal the quantity estimated to have been lost.

4. *The extreme cold hypotension pattern.* Here it is impossible to record the blood pressure, the pulse is not palpable, the limbs are like ice and the lips are ashen. The apex beat is very rapid. There is severe dyspnœa with great restlessness and profuse sweating. This pattern is seen in casualties who have suffered severe hæmorrhage from multiple large wounds. Such a patient will not stand evacuation. He requires urgent transfusion where he is or he will die.

If there is still any doubt about the degree of blood loss, the following additional signs of severe hæmorrhage may be noted : mental alertness, urgent and quenchless thirst, intolerable discomfort and extreme vasospasm so that it may be impossible to get a needle into the lumen of the superficial veins.

If the blood pressure can not be recorded, through lack of a sphygmomanometer, the rate and quality of the pulse beat and the response of the nail bed capillaries to digital pressure are the most reliable signs indicating the state of the blood pressure.

#### THE CRUSH SYNDROME

During the blitz this syndrome was commonly seen after people had been partially buried for some hours or when limbs were severely crushed by collapsed buildings. When the limbs were released from pressure the general condition did not show the signs of traumatic shock. The limbs presented an unexplained erythema, blisters, loss of sensation, paralysis and gross swelling.

After a latent period varying from half an hour to a matter of hours, plasma poured from the circulation into the crushed tissues. The blood volume soon fell below the critical level of 70 per cent. of normal, and this produced the clinical pattern of cold hypotension. Later the crushed limb became ischæmic with tense œdema and impending gangrene. This coincided with the passage of a diminished amount of urine containing blood and albumin. About two-thirds of these casualties died in less than a week from renal failure. A persistently acid urine caused irreparable damage to the kidneys. Even early amputation made no difference to the prognosis.

With these casualties treatment is required urgently to restore the circulation and blood pressure by plasma transfusion. A good output of alkaline urine should be aimed at, to ensure the excretion of myohæmatin and toxic metabolites without their precipitation. In the field and during evacuation, oral fluids should be given at the rate of six pints daily. To each pint two teaspoonfuls of sodium bicarbonate should be added. Many patients, because of vomiting, will only be able to retain small quantities of fluid given frequently.

### CASUALTIES FROM ATOMIC EXPLOSIONS

The bulk of casualties who survive an atomic explosion will suffer from burns and injuries due to ante-mortem burial and flying missiles such as fragments of glass. Sublethal radiation effects will not be an immediate surgical problem. The brunt of the blast effects will fall on air-containing organs such as the middle ear, lungs and gut. It is thought that the damage inflicted on these organs in survivors will be less severe than that inflicted by high explosive blast, such as was seen in the last war, as the human body is said to resist over-pressures of a high degree. Whether or not this is so will probably be proved in the future when statistics become available for publication.

### CHEST INJURIES

Traumatic shock is again due to the reduction of blood volume from hæmorrhage and tissue damage, but in chest injuries the tissue damaged is the specialized lung tissue. When fluid escapes into the lung tissue, cardio-vascular embarrassment ensues. The resulting clinical features are three in number, chest pain, dyspnœa and cyanosis.

These clinical features should be added to the clinical patterns of traumatic shock already described under the heading of limb injuries.

In addition to the general picture of traumatic shock in chest injuries, there are three specific lesions of the chest which produce profound traumatic shock and require prompt treatment if life is to be saved :

The "sucking wound" must be sealed with an air-tight dressing held in place with overlapping layers of elastoplast.

The "stove-in chest" requires oxygen by B.L.B. mask plus fixation of the lower chest wall with elastoplast.

A tension pneumothorax needs urgent aspiration through a wide bore needle in the second intercostal space.

A shock-producing "silent chest lesion" in the presence of some gross wound is easily missed if a routine general examination of the casualty is omitted. For example, the lungs may not have been examined in an obvious G.S.W. of the buttock, yet they may have been damaged and a blood transfusion may be fatal. The location of the apex beat of the heart is a useful guide to the diagnosis.

Tissue damage within the lung results from high explosive blast without evidence of external injury. The blast wave drives the chest wall inwards momentarily. This causes multiple hæmorrhages of varying degrees of severity to be scattered throughout the lung tissue. The pulmonary capillaries are torn and blood escapes into the alveoli and into the lung parenchyma.

Clinically the casualty appears to be dazed and to be suffering from traumatic shock due to blood loss. Yet there may be no external wounds to account for it. The persistent dyspnœa, cyanosis and extreme restlessness should focus the attention of the medical attendant on the chest. The patient usually complains either of constant, deep, central pain from mediastinal hæmorrhages, or of superficial pain from contusion of the chest wall.

The cold hypotension pattern of traumatic shock is present in addition to the signs of cardio-vascular embarrassment. The pulse is very rapid and of poor volume. The jugular veins are prominent. There is no impairment of the percussion note, but the breath sounds are weak and moist rales are audible all over the lungs. Any sputum is usually blood-stained. One or both ear drums may be ruptured.

*Treatment.* All casualties suffering from chest wounds must be treated as stretcher cases, right from the regimental aid post. This lessens the strain on the cardio-vascular system. In the excitement of battle, some casualties resent being carried on stretchers, as they feel fit to walk. This was well illustrated in the case of a young Turk from Cyprus. He was wounded in the chest during a Stuka dive-bombing attack while he was delivering shells to the guns. A bullet passed across his chest, tearing open his left second intercostal space. It emerged through his left biceps. He completed his task, making light of his injuries. On his return journey to the ammunition dump, he stopped at the C.C.S. to get a dressing on his wounds, to keep out the sand. He was most indignant when he was admitted as a casualty. Within an hour of his admission he collapsed while on a stretcher, from grave cardio-vascular embarrassment.

In addition to complete rest, oxygen should be available for administration by a B.L.B. mask. Morphia should only be given with extreme care and in physician's dosage of one-eighth or one-sixth of a grain. Early administration of antibiotics does much to lessen the incidence of later septic complications. Transfusions and anæsthetics should be avoided if at all possible, but if a transfusion is essential, plasma or plasma substitute is preferable to blood.

#### ABDOMINAL WOUNDS

Because the course of missiles in the human body is not predictable, all wounds in the vicinity of the abdomen, especially buttock and perineal wounds, should be

kept under observation as abdominal wounds until proved to be so or exonerated. A silent abdominal wound can very easily be overlooked.

Traumatic shock is again due to the reduction of the blood volume from hæmorrhage and from tissue damage. The peritoneum is specialized tissue which when irritated or damaged reacts by secreting fluid into the abdominal cavity. This reduces the blood volume and produces traumatic shock, but only after the passage of some hours. It is thus possible to distinguish traumatic shock due to severe hæmorrhage from that due to tissue damage by noting the time of onset in relation to the time of wounding. This is of great practical importance in the management of these two different varieties of casualties.

Each group includes about half of the casualties wounded in the abdomen. The first group of casualties, suffering from severe active hæmorrhage, very quickly presents the clinical picture already described as cold hypotension. The majority of this group will die within two hours of wounding from blood loss unless the hæmorrhage is controlled by surgical measures.

The second group of casualties includes all those with perforations of the gut. Over a period of some hours, they develop acute peritonitis. The majority of this group lose less than two pints of blood in that time. If they lose more blood they would probably have been included in the first group.

Severe blast waves may injure the gut, as it contains gas. The injury consists of submucous and subserous hæmorrhages. The clinical picture shows a sudden onset of acute spontaneous abdominal pain, just as if the patient had been kicked in the abdomen. This spontaneous pain persists and is accompanied by nausea, vomiting and a desire to defecate. Very often there is blood on examination per rectum. There is a great danger of perforation of the gut. If this happens the patient slowly develops the clinical picture of cold hypotension with board-like abdominal rigidity and loss of liver dullness.

In the management of these blast casualties, a sequence of brief, accurate, clinical notes, such as the presence or absence of bowel sounds, muscle guarding, etc., recorded during the evacuation of the patient, is of the greatest assistance to the surgeon who will have to decide whether or not laparotomy is necessary.

*Treatment.* All these patients require very gentle handling. No fluids should be given by mouth. Morphia should not be given unless it is obvious that laparotomy will be essential. Antibiotics should be given in such dosage as one million units of procaine penicillin and half a gramme of streptomycin. Both groups of casualties require rapid evacuation towards surgery. They first need immediate pre-operative transfusion followed by urgent surgery. Those who are bleeding very rapidly may die before reaching a surgeon unless they receive a transfusion. Only in such cases is it justifiable to delay evacuation so that a transfusion may be started. The second group of casualties who are bleeding less actively do not need quite such hurried evacuation provided antibiotics have been given early. In fact in emergencies they can be evacuated beyond the C.C.S. before laparotomy, provided gastric suction and an intravenous drip have been set up. They stand a better chance of survival if they travel before rather than after operation.



## THE MANAGEMENT OF CASUALTIES IN THE FORWARD AREA

First-aid measures and early surgery to stop hæmorrhage and to minimize infection are the keystones of surgical treatment. By early is meant within six hours. It is generally accepted that pathogenic organisms require that time to multiply sufficiently to establish infection in damaged tissue. Infection can be held at bay by the early administration of antibiotics, so long as the infective organisms are susceptible to their action. Unfortunately antibiotics cannot penetrate dead tissue where anærobic organisms can multiply and give rise to potent toxins which, unaffected by antibiotics, are absorbed into the circulation to kill the patient.

Transfusion can mitigate the effects of delayed surgery, but every effort should be made for the two to be used together. Prolonged periods of unrelieved anoxia, the absorption of metabolites and excessive amounts of potassium from injured tissues will cause death from renal failure during the post-operative period, despite adequate surgery.

The French Medical Services in Indo-China have used, with some success, what they call "artificial hibernation." This state of suspended animation is induced on the battlefield by means of drugs and cold, in severely wounded men, to eliminate traumatic shock. It is claimed that the patient can be evacuated safely without delay. One day this method of combating traumatic shock may revolutionize the management of severely injured soldiers, but at present it is still too experimental to be put into general use in war.

The cardinal points in the early resuscitation of surgical casualties are described below.

1. *Maintain a clear airway.* A tracheotomy may be necessary, but positioning the patient on the stretcher is usually successful. An unconscious patient should be placed face downwards on a stretcher with his forehead resting on a strong bandage between the handles and his chin clear of the canvas.

2. *Arrest external hæmorrhage* without delay by any of the following methods: digital pressure, elevation, pad and bandage, artery forceps or ligatures. Tourniquets should only be used temporarily in emergencies or as a last resort.

3. *Seal "sucking wounds of the chest"* with a pack and elastoplast to stabilize the mediastinum.

4. *Relieve pain* by giving morphia. The usual dose is one-quarter of a grain given intravenously or half a grain intramuscularly. This drug should never be given by the subcutaneous route to a patient suffering from traumatic shock, because it is not absorbed until the blood pressure has been restored by resuscitation. It then takes effect when it is no longer required and interferes with the recovery of the patient. The dosage given should be recorded legibly along with the route used and the time of administration. Morphia given by tank crews to their wounded companions is often not recorded. This drug should not normally be repeated within

four hours, because of the very real danger of morphia poisoning. It depresses thirst and can therefore contribute considerably to the dehydration of battle casualties. Its administration is contra-indicated in severe shock, in head wounds, chest wounds and in undiagnosed abdominal injuries, unless pain is very severe. While waiting for morphia to soothe a restless patient, ensure that he is not left unattended on a stretcher supported by trestles.

Do not rush to give such a powerful and dangerous drug as morphia for the relief of fear, anxiety or apprehension. Take time to reassure the patient. Three grains of phenobarbitone given intramuscularly is a very effective sedative and induces sleep. An alternative drug is sodium amytal given in three-grain doses intramuscularly. This is especially useful in head injuries.

5. *Dress wounds* with sterile gauze, such as a "shell dressing," to prevent contamination.

6. *Give antibiotics* as soon as possible after wounding to combat or suppress infection. Ideally they should be given with the first dose of morphia. The dosage of penicillin should be half a million units intramuscularly twice a day, because the *Clostridia* responsible for gas gangrene are not inhibited by low concentrations. With abdominal wounds and perineal wounds it is a wise precaution to give, in addition, one gramme of streptomycin twice a day intramuscularly.

7. *Relieve respiratory embarrassment* causing anoxia in chest wounds and in blast injuries to the lungs by giving oxygen through a B.L.B. mask.

8. *Immobilize fractures.* Support and immobilize efficiently all fractures and large wounds to prevent further tissue damage, which will most certainly increase traumatic shock. Injured tissues must be handled with the greatest care. The cardio-vascular system may be so unstable that sudden elevation of a limb may be sufficient to precipitate the onset of profound traumatic shock. This is especially so in the young wounded soldier who is maintaining his vital circulation by intense vaso-constriction. A severely wounded patient should never be turned over to inspect his back unnecessarily. It is much safer to lift him off the stretcher, well supported by orderlies.

No patient suffering from a fracture of a long bone should be evacuated until the fracture has been adequately immobilized. The fractured femur is particularly dangerous in this respect. Even a simple fractured femur may be a fatal injury if evacuated without immobilization.

At the same time the various methods of obtaining immobilization are not without their dangers. In using the Thomas splint care must be exercised to avoid excessive pressure on the ischial tuberosity and the dorsum of the foot. To maintain extension, the outer part of the ring must be padded adequately to prevent the ring from slipping on to the urethra. The distal end of the splint must be fixed firmly to the stretcher to prevent bumping of the injured limb during transportation.

If plaster of paris is used for splinting, every plaster, with the special exception of the Tobruk plaster, must be split for transportation from end to end and from the outside surface down to the underlying cotton wool, because of the ever-present dangers of further hæmorrhage and of the inevitable swelling following high velocity missile wounds.

9. *Maintain blood volume.* Avoid any form of treatment which will lower the blood volume of the patient. After blood loss in any quantity, nature initiates intense peripheral vaso-constriction which results in general pallor and coldness in the limbs. This aims at maintaining an adequate blood supply to the vital centres. It is therefore absolutely wrong to try to heat the patient externally with hot-water bottles, stoves and electric blankets. These measures cause reflex vaso-dilation with a fall in blood pressure and accentuation of the traumatic shock. At the Farnborough air disaster in 1952 many medical officers, both military and civilian, helped to attend the injured. Electric blankets were used by a number of these officers to apply external heat to severely shocked patients. One patient suffering from extreme blood loss suddenly collapsed and died while a blood transfusion was being set up. It was then discovered that an electric blanket had been put over him a quarter of an hour earlier.

By all means preserve the body heat with blankets, but do not heat the patient. Be guided by the patient's feeling of comfort. Heating causes sweating which leads to dehydration. So long as the casualty does not complain of cold he is usually comfortable. A slightly subnormal temperature in a shocked or bleeding patient is harmless and beneficial. During the war at sea it was found that wounded immersed in cold sea water for a time were in much better condition when rescued than could have been expected from the nature of their wounds.

10. *Combat dehydration* by giving fluids orally except in those casualties suffering from abdominal wounds, blast injuries of chest and those who will receive a general anæsthetic within *four* hours. The dehydrated patient is thirsty and feels weak. He has a dry, dirty, leathery tongue and an inelastic skin. His renal function has already been depressed so that the amount of urine secreted has diminished and the non-protein nitrogen in his blood has begun to rise. In the tropics the risk of dehydration is even greater. This is a very common condition in battle casualties, especially as morphia suppresses the desire to drink. With the above-mentioned exceptions every casualty should drink at least six pints of fluid daily. To each pint, a teaspoonful of common salt should be added to ensure an adequate intake of the sodium ion which plays such a large part in maintaining the osmotic pressure of the blood along with the plasma proteins and other electrolytes.

After attention to these ten points the casualty should be ready for evacuation towards surgery. The journey should be as expeditious as circumstances will permit. It should be estimated in hours and not in miles.

## PRE-OPERATIVE RESUSCITATION

When the casualty arrives at the unit where surgery is available, the real problem of resuscitation must be tackled. Everything must be directed towards making the patient fit to stand an anæsthetic and operation. The main therapeutic measure available for this purpose is intravenous transfusion to restore the blood volume. In the last war about 10 per cent. of all the surgical casualties required transfusion. The effects of blast in an atomic war may lower this figure. This estimate excludes burn casualties.

The pre-operative resuscitation ward must be big enough to accommodate a large number of casualties. It should be run by an experienced transfusion officer who is always in close contact with the surgeon and anæsthetist. This can only be done efficiently if the ward is close to the operating theatre. A mobile radiograph machine should be at hand to save moving the patient unnecessarily. The officer in charge of reception should be proud of the expeditious manner in which the 10 per cent. requiring transfusion are passed without delay from the ambulances to the resuscitation ward.

On arrival at the resuscitation ward the patient should be handled very gently. His clothes should be cut up the midline to facilitate examination. They should not be removed until the patient is anæsthetized unless they are wet. Many units fail to provide an adequate number of scissors for this purpose. The transfusion officer should then make a full and rapid examination to determine the nature and extent of the injuries. Very few casualties are so desperately ill that this examination can be justifiably omitted. The systolic blood pressure should be recorded and tourniquets should be looked for. A generous supply of sphygmomanometer cuffs saves much valuable time.

*Transfusion*

The transfusion officer should then decide what fluid to transfuse, how much the casualty will probably require and how fast it should be given. Close liaison with the anæsthetist must be maintained so that the optimum time for operation is not missed.

Transfusion is contra-indicated in head injuries and blast injuries, and should only be given in chest injuries when there is very severe hæmorrhage. In these circumstances small amounts of blood should be transfused very slowly because of the risk of pulmonary œdema.

Over a large number of transfusions given during the last war, the average amount given was four pints, made up of two and a half pints of blood and one and a half pints of plasma.

Since the great majority of the casualties suffer from blood loss, the best fluid to use for restoring the blood volume is blood, so long as its state of preservation can be relied on. During the last war the Army Transfusion Service provided Group O blood, of unknown Rhesus group, of the highest standard. Transfusion reactions due to mis-matched blood were almost unheard of.

When blood is not available, the blood volume can be made good with plasma or serum or with plasma substitutes, such as dextran or plasmosan. The

majority of casualties do not stand operation well when their hæmoglobin level is below 70 per cent. of normal. Nevertheless, the use of these substances enables the circulation to use to the maximum the remaining hæmoglobin for carrying oxygen to overcome anoxia. Lack of blood should never prohibit the use of substitutes. An embarrassed circulation responds better to a less viscid fluid than it does to blood, so that plasma and serum produce a better response when used for the first three pints of a transfusion. These fluids are easier to give than blood and the transfusion runs more rapidly. They can be kept in the resuscitation ward and are available for immediate use in an emergency while blood is being collected from the refrigerator. If the first three pints of a transfusion are not given quickly the response is delayed and disappointing, whereas if the transfusion is given quickly the response is usually dramatic, but if not it should be marked within an hour.

Unfortunately, plasma transfusion has a considerable risk\* of infecting the recipient with the virus of homologous serum jaundice. For that reason many authorities disapprove of using it. To a lesser extent blood and serum both carry the same risk. In atomic war it is likely that the supply of these fluids will be far from adequate, so that dextran and plasmosan will be the fluids available.

In a number of instances the average transfusion of four pints will be inadequate. Casualties suffering from profound traumatic shock due to severe and continuing hæmorrhage causing prolonged anoxia can sometimes be revived by massive transfusions when supervised by very experienced transfusion officers. Heroic efforts are required, and the outlook should be that there is no such thing as a corpse until the funeral. So long as there is blood to pour in and a vascular system to receive it, a man can be kept alive and reasonably fit until his injuries are repaired, if they are repairable.

When the estimated blood loss has been transfused, the systolic blood pressure should be rising. On average, one pint of blood raises the systolic blood pressure about 10 to 20 mm. of mercury. If the blood pressure has not responded, no time should be lost in further transfusion without surgery. The transfusion should be kept running and the patient taken to the operating theatre as soon as possible to find out what is wrong, otherwise he will die.

*Fast transfusion.* The rate of transfusion may be either fast or slow. By fast is meant a pint in five to fifteen minutes, using every possible means to speed it up, such as pressure and multiple giving sets. The fast rate should be used in general for all those casualties where the systolic blood pressure has fallen below, and remains below, 100 mm. of mercury, because their blood volume is below the critical level of 70 per cent. of normal. This, of course, does not include those suffering from the vaso-vagal pattern of shock. The intravenous route should be used except when the heart is failing or has stopped. In these circumstances intra-arterial transfusion may be effective in resuscitating the patient. A large artery is selected, and if blood is not at hand when the emergency occurs, normal saline or dextran is used for the first three pints. Many pints of blood will be

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\* The use of small pool plasma has now reduced this risk very considerably.—Ed.

required, and because of the pressure used to keep the flow going there is a great risk of air embolism. There is also a risk of distal gangrene in the limb.

**Reactions.** Unfortunately, fast transfusion usually brings on varying degrees of transfusion reactions which have nothing to do with incompatible blood. If the blood is unfortunately incompatible, the well-known signs of dyspnœa, nausea, vomiting, rigors and lumbar pain usually appear whenever a few cubic centimetres of blood have been given. Such a transfusion must be stopped immediately. The reactions due to the rapidity of the transfusion take longer to develop and appear after larger quantities of blood have been given. They occur in two phases. The constrictor phase appears first and is followed about an hour later by the dilator phase.

The onset of the constrictor phase is marked by an intense spasm of all the superficial veins. This stops the running of the drip. The patient becomes very excited and restless. He complains of pain in his limbs and in his back. Severe rigors may follow. These rigors may easily displace the transfusion needle from the lumen of the vein. The patient becomes very pale. His limbs become cold. His pulse is impalpable and the apex beat may reach 140 beats per minute.

His blood pressure begins to rise. The rise of blood pressure is due entirely to the intense vaso-constriction and does not mean that sufficient blood has been given to restore the blood volume to normal. This is a trap for the unwary. If the drip has not stopped, the rigors usually improve if the rate of the drip is reduced, but this delays the recovery programme. It is better to give 1 ml. of 2 per cent. procaine solution into a vein. This is usually sufficient to relax the spasm. After that the transfusion is restarted with the aid of pressure, but care is necessary to avoid a fatal air embolism from faulty apparatus.

The dilator phase follows in about one hour. The restlessness subsides and the patient is at peace. He usually breaks out into a profuse sweat, with a flushed face and a bounding pulse which maintains a beat of over 100 per minute. His blood pressure falls, but if the transfusion has been adequate it remains above 100 mm. of mercury.

**Slow transfusion.** The second standard rate of transfusion is the slow one. By that is meant one pint in half an hour. This speed is used when the systolic blood pressure has risen again to 100 mm. of mercury. This indicates that the blood volume has been restored above the critical level of 70 per cent. of normal. The patient should be marking time, waiting for his turn to be taken to the operating theatre, having his blood volume in the vicinity of 90 per cent. of normal. He will then stand the anæsthetic and operation with a much greater margin of safety.

The slow rate of transfusion is also used as a prophylactic transfusion in patients suffering from the pattern of traumatic shock already described as cold tachycardia. In this pattern the blood loss is less than three pints. Many casualties in this category may improve gradually without transfusion and appear to be in surprisingly good condition. Unfortunately, they usually collapse suddenly when an anæsthetic is given, because the blood volume is too near its

critical level. The safest method of treating these casualties is to transfuse them prophylactically in spite of their improvement. Sudden collapse is even more likely to take place in fit young men with limb injuries if the systolic blood pressure is over 140 mm. of mercury.

In spite of apparently adequate transfusion, some casualties either show a poor response or fail to respond at all. This may be due to a number of causes such as continuing active hæmorrhage, the presence of a fulminating infection such as gas gangrene, fat embolism, morphia poisoning, unsuspected lung damage from the effects of blast, prolonged anoxia after wounding from lack of resuscitation and surgery, or from release of a tourniquet which has been in position for a long time. A proportion of these casualties will survive operation, but they, along with all those who have suffered prolonged anoxia, run the grave risk of dying post-operatively from post-traumatic renal insufficiency when the kidneys stop excreting adequately.

Transfusion should not be divorced from surgery, because with massive injuries the need for operation is just as urgent as the need for transfusion. Transfusion should only be used alone as a life-saving measure when the casualty would not reach the surgeon alive. Even a small transfusion may tide a patient over a critical period of traumatic shock, but giving a transfusion in such desperate circumstances is usually exceedingly difficult and time-consuming because of the intense vaso-constriction which is invariably present. Although the transfusion needle may be well within the lumen of a vein, the fluid will not run into the vein. Dextran, being less viscid than blood, runs more easily. The difficulty of giving such a transfusion was well illustrated at the battle of the Rhine crossing in the last war. A keen young medical officer wasted forty-five minutes trying to get a plasma drip running into a casualty showing the pattern of wound shock already described as cold hypotension. He failed and had to evacuate the patient untransfused to the surgical centre, which was sited alongside an excellent, empty road fifteen minutes' journey away. The casualty arrived safely in spite of the delay.

The policy of providing blood in advance of the surgical centres has been mooted from time to time. The disadvantages far outweigh the advantages. The refrigeration difficulties are very great and the use of blood far forward without refrigerators is too dangerous. The availability of blood at that level is very liable to delay evacuation of serious casualties through the enthusiasm of keen young medical officers in their efforts to do their utmost to help the casualties. Attempts to restore fully the blood volume in the forward area are pointless, as the patient's general condition will only deteriorate during his evacuation until surgery is provided. Once a transfusion has been started in the battle area it must be maintained during evacuation to prevent relapse. Ambulance transfusions are all very well in theory, but good nursing orderlies can seldom be spared and only too often the patient arrives at the surgical centre with the needle out of position or with the drip bottle empty. On arrival at the surgical centre, further resuscitation will be required. Secondary transfusion is always less effective and more difficult than primary transfusion. Experience



has shown that blood must be used for this secondary resuscitation ; the optimum time for surgical interference may be missed through bad timing and it is lost for ever.

The views expressed in the above article are personal. I was employed as a surgical specialist in the forward area throughout most of the 1939-45 war and formed these opinions as a result of practical experience, discussions with my colleagues and senior consultants, and through reading publications in the Press of the day.

Unfortunately, I can no longer recall the details of these publications and herewith gratefully acknowledge my indebtedness to my comrades-in-arms : Major-General D. C. Monro, C.B., C.B.E. ; Major-General Sir Max Page, K.B.E., C.B., D.S.O. ; Major-General Sir William Heneage Ogilvie, K.B.E. ; Brigadier Sir Arthur Porritt, K.C.M.G., C.B.E. ; Brigadier John Huston, Q.H.S. ; Brigadier Charles Donald, O.B.E. ; Lieut.-Colonel A. L. d'Abreu, O.B.E. ; Lieut.-Colonel Ian Aird ; Lieut.-Colonel G. A. H. Buttle, O.B.E. ; Lieut.-Colonel Andrew G. R. Lowdon ; Major John W. L. Bain, T.D. ; Major John Swinney, M.C.

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# CERVICAL COLLAR-STUD COLD ABSCESSSES

AN UNUSUAL SITE

BY

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WE can find no record of a cervical cold abscess presenting as an otherwise symptomless swelling in the suprasternal fossa. Such a swelling in this location would suggest a thyroglossal origin, a dermoid cyst, a lipoma or a sebaceous cyst.

Hamilton Bailey (1945) in an account of 200 cervical collar-stud abscesses gives the following incidence of the site of the causative tuberculous gland:

Submaxillary triangle ...	...	...	15 or 7.5 per cent. of cases.
Upper jugular chain ...	...	...	143 or 71.5 per cent. of cases.
Middle jugular chain ...	...	...	10 or 5 per cent. of cases.
Supraclavicular triangle ...	...	...	12 or 6 per cent. of cases.
Posterior triangle ...	...	...	20 or 10 per cent. of cases.

None of the cervical collar-stud abscesses occurred in the suprasternal fossa.

Again according to Hamilton Bailey, in approximately 25 per cent. of cases the superficial abscess does not overlie the breaking-down glands that feed it. The factory and storehouse may be as much as 6 to 8 inches apart. In the surgical treatment of these conditions he considers it fundamental to remove not only the storehouse but also the factory and the tunnel which connects one with the other. That was written in 1945 and probably the only addition to it now would be an anti-bacterial drug therapy and sanatorium régime.

Details of the two cases of cold abscess in the suprasternal fossa are as follows:

## Case 1.

A 20-year-old member of the W.R.A.C. reported sick on board ship to Singapore in May, 1954, with a small painless swelling in the suprasternal fossa. Previously her health had been excellent and she had not come in contact with any infectious diseases. She was given no treatment at that time.

On 9th June she was admitted to B.M.H., Singapore, as the swelling had increased in size and was now the size of a large cherry. In all other respects she felt well. The swelling was tethered to the overlying skin, which was reddened. On the 15th it was incised and pus and fragments of the wall were evacuated. The pathological report on this material stated "giant cells of the Langhans type and occasional small tubercles; a few areas of necrosis but no

true caseation." Chest radiograph showed bilateral apical opacities consistent with the appearance of tuberculosis. The erythrocyte sedimentation rate was 33 mm. (Westergren) in the first hour. On 1st July chemotherapy was started, consisting of streptomycin, 1g., and *para*-amino-salicylic acid (PAS), 20g. daily. This was continued until 14th August, 1954, when streptomycin was given every third day and PAS continued daily.

She returned to U.K. by hospital ship and was admitted to the Connaught Hospital on 11th September, 1954. At that time she had a 4 cm. scar in the suprasternal fossa, 1 cm. above the upper edge of the sternum, the centre of which was oozing serous liquid and required daily dressings. Swabs of this discharge grew only coagulase-negative *Staphylococcus aureus* and no tubercle bacilli.

Apart from the neck sinus no clinical abnormalities were detected: hæmoglobin, 80 per cent.; W.B.C., 10,000 per cu. mm. (P, 60; L, 37; M, 1; E, 2); E.S.R., 27 mm. Gastric lavage and laryngeal swabs were negative on culture for tubercle bacilli. Chest radiograph and tomograms showed bilateral apical streaky opacities with no cavitation.

On arrival, chemotherapy was changed to streptomycin, 1g. and I.N.A.H., 200 mg., on every second day.

She made satisfactory clinical and radiological improvement but the neck sinus did not heal, and on 6th December, 1954, excision was performed by Mr. G. Kent Harrison. At operation the sinus track was found to pass behind the sternum in the mid line for 2 cm. inferior to the superior edge of the sternum. No bony involvement was found. Examination of the excised sinus track showed extensive fibrosis with round cell infiltration and tubercle formation. No tubercle bacilli were grown on culture.

Since then the wound has remained well healed and shows no signs of breaking down. Radiologically the bilateral apical opacities are resolving. There was no evidence of mediastinal lymphoglandular enlargement.

## Case 2

This 18-year-old butcher's assistant joined the army in May, 1954. He had no previous history of illness apart from the usual childhood ailments and there was no relevant family history.

Early in July, 1954, he noticed a small, soft painless swelling in the suprasternal fossa. It gradually increased in size during the next three weeks until, when it was about the size of a pigeon's egg, he reported sick. He was seen at a hospital where a diagnosis of dermoid cyst was made. His name was put down for admission for operation as soon as parental consent was obtained.

Towards the end of August he noticed that the lump was increasing more rapidly in size and that the skin over it was becoming red and thickened. On 20th August, 1954, the reddened skin broke down and discharged a little thin yellow fluid.

He was admitted to a hospital and on 5th September an operation for the excision of what was still thought to be a dermoid cyst was performed. At operation it was found that the swelling was in fact the head of a large collar-stud

abscess, the base of which lay in the superior mediastinum behind the sternum. No actual pus was found, but a large quantity of necrotic material was removed.

The pathological report on part of the tissue removed at operation stated that the subcutaneous tissue had been replaced by tuberculous granulation tissue consisting of lymphocytes, plasma cells, epithelioid cells and giant cells. There was also a little caseation present. No tubercle bacilli were found on either direct smear or culture.

A chest radiograph showed the presence of two large, partially calcified right paratracheal lymph glands. The lung parenchyma was radiologically normal.

A diagnosis of tuberculous collar-stud abscess secondary to a mediastinal tuberculous adenitis was made.

The neck scar healed completely within 14 days.

The patient was treated with three months' bed rest, followed by three months' up-grading. He received 1 g. of streptomycin daily for 30 days, followed by 1 g. on alternate days to the end of his six months' treatment. On each day that he received streptomycin he also received I.N.A.H., 100 mg. b.d.

### COMMENT

It would appear beyond doubt that the factory in each case was a mediastinal lymph gland.

In Case 1 there are presumably partially calcified paratracheal lymph glands. It would appear realistic to suggest excising these glands, as no doubt they are a reservoir of multitudes of tubercle bacilli and a potential danger, but as that would involve a formidable operation, and as the patient would appear to have done well, we have let the matter rest.

In Case 2 there is bilateral apical pulmonary disease, no doubt the result of hæmatogenous dissemination. There is no radiological evidence of an old primary focus in the lung, but doubtless the mediastinal component of the primary complex remains and was the source of the cold abscess.

In neither case was the factory excised. Theoretically it might be wise, but practically in both cases the present line of treatment is probably better.

### SUMMARY

Two cases of cervical collar-stud cold abscess presenting as otherwise symptomless swellings in the suprasternal fossa are described.

The source of each is undoubtedly tuberculous mediastinal lymph glands.

The site and source of these two cervical cold abscesses are rare. We can find no previously recorded case.

We wish to thank Mr. G. Kent Harrison, F.R.C.S., civilian specialist in thoracic surgery, Connaught Hospital, Bramshott (Army Chest Centre), for his help.

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## NOTES ON AN ARMY MEDICAL CENTRE IN FARELF

BY

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G.H.Q. FARELF, the G.H.Q. of the Naval C.-in-C., the office of H.E. the Commissioner-General and various other smaller units of U.K.-based civilians are situated in the pleasant residential area of Tanglin. All of these units are accompanied by a substantial panel of families, and it is the army's responsibility to provide for their medical care.

For the purposes of medical cover the island of Singapore is divided into areas, each of which becomes the responsibility of the Service Medical Centre provided, irrespective of service differences between centre and patient. These families are disposed about the island, largely in private accommodation—hotels, boarding-houses, rented houses and service quarters. Thus each area contains members of all the services and no discrimination occurs.

The Medical Centre at Tanglin functions closely on the lines of civilian practice. It constitutes a three-doctor group running four consultation sessions daily, each doctor being free both morning and afternoon for domiciliary attendance. There are autonomous dispensing and out-patient treatment facilities.

The Centre itself is built on an intelligent plan and admirably serves the dual purpose, on the one hand as a families' and officers' Medical Centre, and on the other as a Medical Centre room for troops. The disposition of the building is conveniently symmetrical. Centrally, on opposite sides of a short corridor, are the reception office and the dispensary. On either side of the central reception office are the twin waiting rooms, each communicating with its large airy consulting room, the latter in turn flanking the dispensary. Each consulting room leads into its own treatment room. The western treatment room is the larger and is devoted to officers and families, while the other is used for the treatment of troops. Beyond the larger treatment room there is a rest room for the female staff and toilet accommodation for ladies. The eastern section, beyond the other rank treatment room, contains the general office, the male staff billet, toilets for officers and troops, a bathroom and a store room.

In order to induce a mood of optimism in the patients, the waiting rooms and consulting rooms are decorated with framed reproductions of paintings by Vincent Van Gogh and other Dutch artists, flowers are provided on the desks, and there are comfortable armchairs, occasional tables and a supply of magazines in the waiting rooms. Window curtains are non-standard and attractive and cushions are covered in floral pattern material.

The establishment of the Centre is unusual by reason of its miscellany. The unit is under the command of a R.A.M.C. medical officer, holding the temporary rank of major. The second doctor is a captain or lieutenant, R.A.M.C., and the third a surgeon lieutenant, R.N. The latter is lent to the army in return for the

care afforded by us to the large number of naval officers and families on our panel. His duties are by no means restricted to attention to naval personnel, but he is primarily responsible for their care.

The N.C.O. in charge of the Centre is a sergeant. His staff consists of a R.A.M.C. medical orderly, a regimental medical orderly who functions also as a clerk, a Q.A.R.A.N.C. corporal who is in charge of the officers' and families' treatment room, and her assistant, a W.R.A.C. medical orderly. The Q.A.R.A.N.C. corporal is on temporary duty for three months and is then returned to her parent unit. In charge of the dispensary is an experienced Indian hospital assistant who is fully trained in his duties. Two cleaners are employed in a full-time capacity—an old Indian hospital boy and a young Chinese girl.

The male orderlies are responsible for the maintenance of a 24-hour-a-day telephone watch, and the girls, who are accommodated in the W.R.A.C. billets just behind the Medical Centre, are on call alternately. If required in the evenings, the female orderly on call is available within a few minutes.

A staff car and driver is on permanent 24-hour duty to the Centre, and an ambulance car stands by at all times during working hours.

Attention to the troops follows routine sick-parade lines. They are seen in their own consulting room, given treatment slips, and attend at one or any of three treatment periods during the day.

Officers and families, on the other hand, are seen only by appointment (except in urgent cases) and there is consequently little waiting. On arrival, patients report to the orderly in the central office, their appointments are checked and they are asked to sit in the adjoining waiting room. They are then called into the consulting rooms by the doctors. Patients too ill to attend as out-patients notify the Centre, usually by telephone. All calls are at once recorded in a register. Patients are asked to indicate which doctor normally attends to them. If possible, this doctor will then take the call. Doctors are usually free to leave on their domiciliary rounds by 1100 hours after morning consultations and by 1545 hours after the afternoon session.

Two offices have been found to be necessary for effective administration: the central reception office and a second larger and more isolated office used for general business. In the central office are kept the registers for consultation appointments, outside calls, inoculation and vaccination and for appointments with specialists. The other office contains all the unit files, a lock-up filing cabinet for "F.s Med. 4" for officers and troops, a typewriter and stationery. Stocks of "F.s Med." are maintained in numerical order to facilitate access.

Families' records are kept conveniently on "F.s Med. 5." A separate card is kept for each individual, the husband's or father's name and the address being recorded. The cards are filed in specially made boxes and are arranged alphabetically. Each doctor has his own set of cards, but these are interchanged if necessary. Separate families' files are kept for "F.s Med. 7," "12" and "14". All families' documents are thus easily accessible. When the families attend for the final "FFI" inspection prior to embarkation or emplanement they are

handed all medical documents in an envelope and asked to give them to their next medical officer. Some continuity in documentation is thus achieved.

The scope of work in this Centre, within the limitations of any general practice, is restricted only by the skill or confidence of the doctors. There are excellent facilities for minor surgery and other practical procedures. A good deal of "casualty" work is undertaken. The incidence of certain disease groups is high enough for a statistical approach to treatment to exist, and there are opportunities for simple research, especially in dermatology and psychopathology.

In broad outline the practice resembles that in civilian life under the National Health Service. Radiographical and laboratory facilities are freely used and consultations with specialists are frequently arranged. For these purposes patients go to the B.M.H., Singapore, which is about two miles away.

In relationships with patients the doctors encounter exactly the same problems as occur in civilian practice. The nature of the practice is not materially altered by the tropical climate, except for a slight exacerbation of the incidence of neurosis, respiratory infection and the pyo-dermatoses. Minor gynæcological upsets are also rather more common than in the U.K. and pædiatrics tends to form a larger proportion of the practice.

Because of its geographical situation the demand on the Centre for inoculation and vaccination is heavy. Many in transit from Malaya and Hong Kong report here for immunization before proceeding to the U.K. It has been found necessary to run three inoculation sessions weekly. These are held at 1600 hrs. No appointments are made in advance, but on arrival the names are entered consecutively in the register. Patients are then called in order into the consulting room after being handed the appropriate International Certificates, ready stamped and dated. The doctor performing the inoculation is assisted by a female orderly. The multiple puncture technique is employed in vaccination and the incidence of failures is low. Much immunization against diphtheria and whooping-cough is undertaken.

The following figures, referring to the year ending 30th April, 1955, give some indication of the volume of work: Out-patient consultations: families, 6,804; officers, 1,306; W.R.A.C., 913; domiciliary visits, 1,714; inoculations and vaccinations, 3,546. Total, 14,283.

### SUMMARY

An army Medical Centre is described which is unusual because a large proportion of its panel consists of U.K.-based civilians, and because it employs a naval medical officer. Mention is made of attempts to simulate civilian practice and to minimize depression in patients attending. There is comment on the effects of tropical climate on the incidence of disease and figures for attendance are quoted.

Appreciation is expressed to Brigadier D. Bluett, O.B.E., Director of Medical Services, FARELF, for the original stimulus to write this article.



## THE USAREUR\* MEDICAL-SURGICAL CONFERENCE

LANDSTUHL, GERMANY, SEPTEMBER, 1955

BY

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DURING the last five years the frequent conferences held by the Medical Corps of the United States Army in Europe at its larger hospitals in Germany have become an established feature of European military medicine.

The most recent of these conferences was held on 16th-17th September, 1955, at the U.S. Army Hospital, Landstuhl, on the borders of the Saar. More ambitious in scope and better attended than previous meetings, it also introduced the newly appointed USAREUR Surgeon, Major-General Alvin L. Gorby, an old acquaintance of the R.A.M.C., to a large gathering of American service doctors from Germany, Austria, France and Britain.

Among those invited to attend were the civilian consultants in orthopædic surgery and psychiatry to the Surgeon General's Office in Washington, medical officers from the Canadian Army and Royal Canadian Air Force, and the Consultant in Surgery and the Adviser in Psychiatry to Headquarters, British Army of the Rhine. The programme was a most extensive one covering a wide field in clinical medicine, surgery and psychiatry, and included papers on dental surgery and special nursing.

Each paper given by a member of the hospital medical staff was limited in duration to twenty minutes. After a five-minute commentary by some senior specialist or distinguished visitor there was a short period for general discussion. Among many items of interest was an excellent film on the therapy of hypertension and a very good if rather hurried demonstration of service patients suffering from muscular dystrophies and multiple sclerosis. For the active participation of the visitors there were panel discussions and problem cases for diagnosis.

A good deal of attention was paid to the ætiology of psychiatric illness and psychosomatic disorders in service men, and one of the most stimulating and informative of the topics for general consideration was a paper entitled "The Caribbean-Latin Syndrome or Simulated Psychiatric Disease." This subject, although referring specifically to Porto Rican recruits in the U.S. Army, was mainly concerned with the general sociological problem of assimilating small groups of individuals with conspicuously different racial characteristics and cultural backgrounds into the comparatively inelastic structure of a military organization. In its long and variegated history the British Army has coped successfully on many occasions with comparable situations.

The outstanding impressions obtained from this conference were of its efficient and meticulous preparation, and of the manner in which high-ranking

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\* United States Army, Europe.

combatant and executive non-medical officers proudly identified themselves with the interests and professional standing of their medical services. For the practising doctor it was an excellent and instructive programme.

The writer of these notes was particularly impressed by the profusion of senior regular military psychiatrists, and the presence of fully accepted and commissioned clinical psychologists and psychiatric and social welfare workers. It also seemed that American medicine was developing a colourful phraseology of its own after a distinguished surgeon was heard to refer to the "index of suspicion" in a case, indicating the degree of probability of finding a specific disease entity in a patient, after a "hospital work-up," in which he had been subjected to a full range of clinical and pathological investigations.

An official banquet and mutual expressions of good will concluded this conference, and it was felt, certainly by the representatives of the R.A.M.C., that such occasions did much to raise the status and potentialities of service medicine.

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## LIFE IN LADYSMITH

*The following letter dated May 7th, 1900, written from Ladysmith by Lady Bruce, to her brother, Dr. Russell Steele, of Hemel Hempstead, is reproduced by courtesy of her nephew, Dr. Russell V. Steele, and the editor of the "Hertfordshire Hemel Hempstead Gazette". Lady Bruce's husband was at that time Major David Bruce, F.R.S., Royal Army Medical Corps.*

ROYAL HOTEL, LADYSMITH

May 7th, 1900

MY DEAR RUSSELL,

Your letter has been following me about from place to place, and has at last found us. David had a month's leave after the relief, and we spent it riding down to Pietermaritzburg; at least, he did. My horse, which was a regular siege horse, knocked up at Colenso, so I sent him back to his owner, with thanks, and went on by train. After a week at Colenso, where we rode over all the battle-fields, to Mooi River, where we spent another week at a farmer's who had had all his valuable horses taken by the Boers, amongst which was my pet horse that I had sent down to be safe. Then we went for ten days to the Pepworths of Pepworth Hill fame, the said hill being on his property up here. They are nice people and they gave us as much milk, eggs, and vegetables as we could swallow, the three things we most wanted. Then to Pietermaritzburg to buy some garments which were much needed.

I expect if Florrie has been down she will have told you all about our being at Intombi Camp during the siege, but don't know if she has received all my letters; so many went wrong just at first. After Elandslaagte fight David had a bad time, operating for about thirty hours straight off, and as he was head of the

hospital as well it was hard work. Down at Intombi Camp too, he did all the operations himself until about a month before the relief, when he got enteric; fortunately a mild attack. At one time at Intombi he had 1,000 patients in his own hospital, nearly all enteric and dysentery, with nineteen sisters—mostly ill—one R.A.M.C. officer, and seven civilian doctors to help him—one or two of them were on the sick list all the time—and very few trained orderlies, so you can imagine the work he had to do to keep things going.

I made myself useful in many ways—ran a library, looked after the medical officers' mess and tried to make a little go a long way, helped in the operating tent, taking notes and helping the sisters there. All the sisters came to me with their little troubles, so my time was well filled up besides nursing David at the end. I got very limp after the relief and could not digest anything, and only weighed a little over 7 stone 1 lb. That was why we spent our holidays at different farms, and are now nearly normal again. David has now gone to Elandslaagte in charge of a field hospital. I am waiting to see if I can get out there too. He only went yesterday, but I am afraid they won't let me, so I shall have to "sit tight" here at the hotel. I wish they would move on and finish the war.

"Horse sickness" has just started to make matters worse. If only it would freeze and put a stop to it! It won't do to lose all the horses now, after already having eaten so many of them; and very good food they are I can tell you, much nicer than old trek ox, though I had to disguise the fact from some of the people at the mess who thought they could not eat horse.

Wasn't it nice, David being made a Fellow of the Royal Society? They must think his work well done. I know it was conscientious work, but we didn't think other people would see it in the same light.

With love to you all,

Your affectionate sister,

MARY E. BRUCE.

## *Editorial*

### A MEDICAL OFFICER TO H.M. BODYGUARD\*

IN May, 1856, occurred an event unique in the history of the Medical Services of the British Army, when a retired Staff Assistant-Surgeon was appointed a member of Her Majesty's Bodyguard of the Honourable Corps of Gentlemen-at-Arms. There was neither merit nor distinction in Dr. Charles Alexander Lockhart Robertson's election, nor was there any reason why other of his fellow-officers should not have joined him in the Corps, for admission was then mainly by purchase, and continued to be so until Dr. Robertson had resigned from its ranks. Nor was his place any recognition of medical prowess, for the Honourable Corps did not and does not include a medical officer in its establishment.

The hundredth anniversary of Dr. Robertson's appointment may, however, provide occasion for wondering whether perhaps the Honourable Corps might not furnish one place for a retired medical officer of the army. Certainly no precedent or parallel can be found as the basis for such a suggestion. The number and ranks of the officers of the Bodyguard have remained virtually unaltered in almost 450 years, and even to think of alteration now may be considered as verging upon impertinence.

If we look farther afield, to the Queen's Bodyguard for Scotland, the Royal Company of Archers, we shall find a Surgeon in the establishment of officers. But the origins, the constitution and the composition of the two Bodyguards are entirely different. One is selective, the other elective, each reflecting its national genius in its customs and traditions. Medical men are not infrequent in the ranks of the Royal Company; some of them have held rank and office in it, other than as Surgeon; and in any case the appointment of Surgeon (originally Surgeon-General) was established only in 1807, long after the foundation of the Company, but fifteen years before its recognition as H.M. Bodyguard.

Nevertheless, reasons may be found for supporting a proposal to number a Surgeon among the officers of the Gentlemen-at-Arms. That Corps has not always borne its present character of a band of retired combatant officers of distinction: its constitution has resulted from acts of alteration, reform and, it may be thought, improvement over little more than the last hundred years. Secondly, these acts have originated or developed from the Royal interest in the Bodyguard, an interest which over the same hundred years has constantly been extended to military medicine. Thirdly, a surgeon may be thought appropriate to a corps which has seen active service in its corporate capacity, even though the battle honours borne upon its standard antedate by over 150 years the earliest honour of any other corps. Fourthly, there is no honorary distinction available for the retired medical officer of the Army. The Honorary Physicians and Surgeons to the Queen correspond with the Aides-de-Camp General and Aides-

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\* Written by the late Colonel J. B. Neal, T.D., Royal Army Medical Corps.

de-Camp drawn from the combatant branches, and so long as they could continue in office for life, there could be no justification for looking farther.

But for fifty years past, the Honorary Medical Officers have been required to vacate their appointments upon retirement. The observation of Dr. Andrew Smith, Director-General of the Army and Ordnance Medical Departments, in 1855, that "honorary awards are much desired and esteemed by the majority of men," remains true, and one such award available to retired medical officers would probably not be thought excessive. Opportunities of appointment would occur infrequently, and there could be no difficulty in finding an officer who could fulfil all the conditions laid down for combatants, except possibly in point of age, and who had attained not only military, but also professional, distinction. The surgeoncy to the Honourable Corps would be an honour of quite a different kind from appointment as a Colonel-Commandant. The qualities to be recognized and the type of man in whom they are found coincide no more closely than would the duties of the two officers.

Dr. Robertson's appointment as a Gentleman-at-Arms in 1856 can in no way be alleged as a precedent, but it may be that, should the Royal Army Medical Corps ever be thought to merit yet another mark of the Sovereign's esteem, this is a manner in which it might be manifested.

## Correspondence

R.A.M.C. OFFICERS' MESS

B.M.H. CYPRUS

BRITISH FORCES POST OFFICE 53

3rd December, 1955

### *Eosinophilia and Helminthiasis in Mauritians and East Africans*

SIR,

I read Captain Cronk's article with interest. Tropical eosinophilia in its fully developed form is common in Mauritians ; no doubt it occurs in a mild form too. It would have been as well to include controls.

There are two infestations of Mauritians not referred to. Some 10 per cent. show the microfilaria of *Wuchereria bancrofti* in their blood when taken at about 10.30 p.m. and thoroughly searched ; probably 20 per cent. are infected, most of them without clinical manifestations. *Acanthocheilonema perstans* is common amongst Africans. The manifestations of the former are not common, but many surgeons have been misled into thinking the patient had tuberculous epididymitis.

*Trichostrongylus* infestation is also common and is frequently mistaken for hookworm or *Strongyloides stercoralis*. The ova are similar to those of Hookworm in appearance and in their reluctance to develop into larvæ. They are slightly larger. The infestation is benign, rarely if ever causes anæmia and is resistant to treatment.

The treatment of most forms of helminthiasis is unsatisfactory with the exception of hookworm, which responds well. If then a man presents with ova

reported as those of *Ankylostoma duodenale*, with no anæmia and there is no response to treatment, he almost certainly has strongyloidiasis. The infestation is surprisingly little known, but can usually be ignored.

I have also seen balantidiasis in a Mauritian (with no eosinophilia). It was a chance finding and did not trouble him, though I have read that this infestation can be dangerous.

I am, etc.

D. HAMILTON, *Major*, R.A.M.C.

MEDICAL CENTRE,  
MAINDY BARRACKS,  
CARDIFF.

### *A Treatment for Athlete's Foot*

SIR,

Although many say that a National Service doctor gets little medical experience in his two years' service, I have not found this to be the case. Amongst other general experience, I have learned of a very effective treatment of athlete's foot, which is, by its nature, a prevalent malady in the army. The following treatment is cheap and I have found it more effective than any other, including proprietary preparations on the market.

The first essential is, of course, good foot hygiene ; daily washing of the feet with proper drying especially between the toes ; clean socks daily, preferably thick woollen which absorb the sweat. Foot powder should be used in the shoes, but *not* sprinkled over the bare feet or inside the socks as this tends to get into cracks in the skin caused by the disease, and, being an insoluble foreign body, tends to delay healing. Finally the patient should be warned to keep his washing material to himself and avoid walking about bare footed, thus spreading the infection to others.

After washing and drying the feet, they are painted with a 40 per cent. solution of formaldehyde, care being taken to paint between the toes. The feet are then allowed to dry in the air. No attempt should be made to remove dead skin as by doing so cracks in the skin may be widened and healing prolonged ; the dead skin will separate on its own when ready. When the feet have dried, an emulsion, consisting of equal parts of lanolin, castor oil and liquid paraffin, is gently massaged into the skin of the feet, again not forgetting the area between the toes. After this *clean* woollen socks are put on, and foot powder sprinkled into the shoes. The treatment should be carried out twice daily.

I have found that all cases on this treatment have shown marked improvement within five days, and most have been cleared up by ten days, many in less time. Also victims of "sweaty feet" with waterlogged soggy areas on the soles of the feet have found marked relief from this treatment, which seems to decrease hyperhydrosis.

I feel that this treatment may be of interest to many in General Practice, especially at this time of year when the disease is more prevalent.

I am, etc.

D. HOOKER, *Captain*, R.A.M.C.

## Obituary

ARTHUR FELIX, D.Sc., F.R.S.

THE sudden death of Dr. Arthur Felix on 4th January deprived the world of science of a remarkable personality, and our Corps of a very loyal friend. Felix was born in 1877 in Silesia, then a part of Poland, and received his schooling in that country. As a young man he migrated to Vienna, where he studied and qualified in organic chemistry. Thereafter he turned his attention for a time to mycology, and on the outbreak of war in 1914 was commissioned in the Austrian Army and posted to his native Poland, where he worked in association with Weil on the laboratory diagnosis of typhus fever. After the war he studied for a short time in Prague, then in 1921 went to Palestine to an appointment in a hospital laboratory in Tel Aviv. In 1927 he came to Britain to join the staff of the Lister Institute, and thereafter made this country his home. On the outbreak of war in 1939 he transferred to the Emergency Public Health Laboratory Service, and ultimately became head of the Enteric Reference Laboratory at Colindale. He retired from this appointment in 1954, and returned to the Lister Institute, where he was still engaged in active work at the time of his death. In 1943, in recognition of his outstanding scientific work, he was elected a Fellow of the Royal Society.

Felix made his first important contribution to scientific knowledge in collaboration with Weil. While investigating antibody formation in patients suffering from typhus fever, they detected an agglutinin for an organism which they had recovered from a patient's urine, and which they suspected might have some etiological significance. However, the bacillus, which they designated "X," proved to be a non-motile strain of *Bacillus proteus*, which, as we now know, is not the cause of typhus fever. Nevertheless, the observation that it was specifically agglutinated by the serum of typhus fever patients proved to be valid and of diagnostic significance, and they proceeded to elaborate the test which bears their names, the Weil-Felix reaction. Subsequent work showed the explanation of the phenomenon to lie in the fact that certain strains of *Proteus* have an antigen in common with the *Rickettsiæ* which are the cause of typhus fever. The test has now been amplified and is used for the differential diagnosis of the various types of this disease.

Their interest was also aroused by the peculiar characters of the non-motile *Proteus* organism, and further investigation culminated in the differentiation of flagellar and somatic antigens, a discovery of great importance to the proper understanding of the antigenic structure of all the coliform organisms.

On joining the Lister Institute Felix turned to the study of the antigenic structure of enteric group organisms. It will be of interest to members of the Corps to recall that at this same time the subject was being investigated, along somewhat different lines, at the R.A.M. College, and that in 1932 Perry, Findlay and Bensted published the results of their work on the rejuvenation of the Rawlings strain of the typhoid bacillus which had been used for nearly 30 years in the manufacture of T.A.B. Vaccine. Two years later, in 1934, Felix provided the

explanation of this rejuvenation by his discovery of a hitherto unsuspected surface antigen, normally present in freshly isolated strains of the typhoid bacillus, but apt to be lost through degradation after prolonged periods of artificial culture. This antigen was found to be directly associated with the virulence of the strain, and was named by Felix the "Vi" antigen. This observation was the starting-point of a long series of investigations which Felix carried out over a number of years. He showed by experiments in laboratory animals that this antigen plays an important part in immunization, and argued that vaccine for prophylaxis must, to be effective, contain it in maximum quantity. He found that "Vi" antigen was destroyed by heat and impaired by antiseptics, but ultimately showed that alcohol, in concentrations which were lethal to bacteria, had no appreciable effect on it. On the basis of this discovery, he devised the process for the manufacture of what is generally known as alcoholized, as opposed to phenolized T.A.B. vaccine.

Felix also applied the principle of using an inoculum of typhoid bacilli rich in "Vi" antigen to the preparation of therapeutic antiserum. Although preliminary trials of this antiserum gave some promise, it was never used on more than an experimental scale. It proved necessary to give large quantities of the serum to produce significant results, and reactions in the form of serum fever and even of acute anaphylaxis were sufficiently common to constitute a serious objection to its use. The advent of chloromycetin sealed its fate.

In 1938 Craigie and Yen discovered the method of typing typhoid bacilli by means of bacteriophage. Felix was quick to grasp the importance of the discovery, and in collaboration with Craigie, and later independently, applied himself to its elaboration and elucidation. His laboratory at Colindale ultimately came to be recognized as the International Enteric Reference Laboratory and Bureau, and as its head he was in regular communication with workers on phage typing all over the world. One of his last publications was a comprehensive review of the world distribution of the different phage types of typhoid and paratyphoid B. He also elaborated methods of typing *Salmonella typhi-murium*.

Felix was a meticulously careful worker. He gave much thought to the planning of his experiments, and used elaborate controls. During the greater part of the time he worked in this country he had the services of one devoted technician whom he had trained and who knew all his little ways, but in spite of this Felix himself carried out most of the manipulations in his experiments. His results were recorded in his own handwriting with great precision and neatness. He had complete confidence in his findings, and was prepared to defend his conclusions against all comers.

Because of common interests, the Army Vaccine Department, first at the R.A.M. College and later at Tidworth and Everleigh, kept constantly in close touch with Felix and his work. Strongly convinced that alcoholized vaccine was in every way superior to the standard phenolized variety, he never lost an opportunity to press for its adoption in the Army, and in 1943 he won his case. A gradual substitution of alcoholized for phenolized vaccine took place in the next few years and it was one of his bitterest disappointments that this had not



the decisive effect he had anticipated. In 1946 Felix became a member of the Army Pathology Advisory Committee, and attended its meetings regularly. He was never loath to express his views, which were frequently in conflict with those of other members, and in consequence he kept the committee very much "on its toes." All this was done in good humour and without malice, and there is no doubt that Felix enjoyed his position as "leader of the opposition." In spite of differences of opinion which were sometimes acute, he was always happy to help in planning and carrying out experiments, and in demonstrating the elegant techniques he had perfected. The atmosphere, if controversial, was fundamentally a very friendly one.

Felix occupied a unique niche in microbiological circles, where he was a very well-known figure. He was a member of most of the societies, attending their meetings with regularity, and rarely failing to take part in the discussions which followed the reading of papers, where he attracted notice because of his strong foreign accent, his somewhat halting delivery, and by the fact that he almost always had something worth while to say. Despite his long residence in this country, he never really became assimilated into the community, perhaps because of his Zionist leanings, which, however, he never paraded openly. To casual acquaintances he must have appeared aloof, distant, perhaps even aggressive. This was not the real Felix known to his friends. Behind the stubborn facade lay a humorous and kindly nature. He was quick to respond to friendly advances, eager to give help where he could and where it did not clash with his own convictions, and always forthright and loyal. No one can fill his place, and we shall always miss him.

J. S. K. BOYD

M.H.P.S. writes :—

On my first appointment to the David Bruce Laboratories in 1949, Dr. Felix responded warmly to my wish to learn more of his methods and went out of his way to make me welcome in his laboratory at Colindale. He took a great personal interest in our work at Everleigh because, as he used to say jokingly, "his reputation was bound up with ours."

I naturally fell under his spell and felt deeply for him during the controversies over the relative merits of his alcoholized and the phenolized vaccine, when he behaved with such admirable restraint. He regarded himself as "the man in the dock" as he once put it, though it is fair to remember that Dr. Felix was not a member of the committee which made the decision to introduce alcoholized vaccine in the Army.

Dr. Felix was a lucid exponent and an exacting teacher. If he gave one a paper, he expected its contents to be remembered. "But that point was answered in the paper I gave you" was a rebuke I earned more than once. Others have referred to his meticulous techniques and the beautiful records of his work which were an example and model for all.

It has been well said that Dr. Felix was "first and foremost a scholar." To me, he played the part of Abib "all-sagacious in our art" to my Karshish "the picker-up of learning's crumbs." When overseas, I corresponded regularly with

the "Sage at home" who was always glad to hear about the progress of our enteric work in M.E.L.F. and was ever ready with help and advice.

Dr. Felix's last years were not only clouded by his disappointment over the high hopes he had entertained for his alcoholized vaccine but also darkened by overwhelming private grief in the death of his only son. In spite of this, with failing health, he rallied like Browning's Grammarian, to continue his work and like him again, "Dies ere he knows it."

"Leave him—still loftier than the world suspects,  
Living and dying."

#### THE LATE LIEUT.-COLONEL J. D. CRUICKSHANK, M.D., R.A.M.C.

In the death of Lieut.-Colonel J. D. Cruickshank, the Corps has lost another pathologist of distinction and an officer of high promise. He was drowned on 22nd October, 1955, while trying out an underwater breathing apparatus near Singapore.

James Durno Cruickshank was born in 1911, the eldest son of the Reverend W. W. Cruickshank. He was educated at Rossall School and studied medicine at Birmingham University. After qualifying in 1933 he held house appointments at the General and Queen's Hospitals, Birmingham, and at Hull Royal Infirmary. He joined the Royal Army Medical Corps in 1935, and served in India from 1936 to 1945, where he gained considerable experience of field medical units. He commanded the 6th Indian Field Ambulance in India and Burma and rose to the rank of Colonel as Assistant Director of Medical Services. After the war, he returned to the United Kingdom and passed the Senior Officers' Course, taking pathology as his speciality. He took the D.T.M. & H. in 1947 and was graded a senior specialist in physiology as well as pathology.

He became Assistant Director of Pathology, Western Command, in 1948, and from 1949 until July, 1954, he held a specialist appointment at the Chemical Defence Experimental Station, Porton, where he specialized in the medical aspects of chemical warfare. He was a member of the editorial committee of the 4th edition of the Medical Manual of Chemical Warfare.

In 1946 he married Isabel Catherine, daughter of the late Sir John Ledingham, F.R.S., and is survived by her and four daughters to whom we send our deepest sympathy in their tragic bereavement.

Brigadier G. T. L. Archer writes :

James Cruickshank was an experienced pathologist and physiologist. He was indeed unique in the Army in being upgraded as Senior Specialist in both these branches of medical science. He was quiet and self-effacing in manner and was thus sometimes hesitant to volunteer an opinion on a problem under discussion. When his opinion was sought, however, it was most valuable, well considered and carefully expressed. He had a strong sense of humour to which he gave expression at times in dryly witty but never unkind comments on persons and affairs. He was an admirable professional colleague and charming social companion and will be much missed in both capacities by many friends and colleagues.

## ***Book Reviews***

**SURGEON AT WAR.** Lieut.-Colonel J. C. Watts, M.C., F.R.C.S., R.A.M.C.  
George Allen and Unwin. Pp. 165. Illustrated. 12s. 6d.

Buy this story of John Watts' surgical experiences in the Middle East, France, Far East and Japan. It includes the principles of war surgery told in simple language.

C. M. M.

**MANUAL OF ARMY HEALTH, 1954.** War Office Code No. 10157.

Until the publication of the 1954 Manual, officers of the Royal Army Medical Corps had to rely upon a number of different sources for reference on army health subjects. "Field Service Hygiene Notes, India," is a most excellent and useful book but necessarily with a strong Indian bias. The Handbook of Army Health, 1950, is intended mainly for the non-medical reader, and the earlier manuals of hygiene and sanitation are largely out of date. For this reason the appearance of the new manual has been awaited with keen interest and it is as well to say at the outset that it achieves a high standard.

It is a substantial volume of 686 pages, with 113 figures and 25 tables, published in the loose leaf form now widely adopted for army manuals. There are 18 chapters, covering all aspects of Army health, and a useful index—although, strange to say, the first subject chosen at random—"Mass Miniature Radiography" (page 543)—could not be found in the index; and there is one example of alphabetical sequence not being strictly maintained.

A very full and informative chapter on the Effects of Climate revives an old wish that Army Health officers might be equipped with the necessary instruments for assessing thermal environments. The chapter on water supplies brings the information in previous manuals up to date by including a very lucid account of "break-point" chlorination. A full account of selection procedure is to be found in Chapter 15, which contains a great deal of information on the subject, not otherwise readily available to medical officers.

The largest sections of the book are those concerned with the control of disease, and the profusely illustrated chapter on arthropod pests. Amongst the many appendices, that on the "Nutritive Value of Foodstuffs" is a particularly welcome source of reference.

The manual, as it stands, is such a mine of useful information that it may be unreasonable to ask for more. In the chapter on "Insecticides and Repellents" more might be said about some of the more recent insecticides and methods of dispersal. The note to Chapter 11, however, makes it clear that the omission is an intentional one. There is no information on the hygiene problems of civil populations in war time. This is a subject which might possibly have been included in view of the present close integration of the army with Civil Defence.

In a work of this scope, covering such a wide variety of subjects, it is inevitable

that there should be minor points on which some will disagree. For example, on page 57, the word "Brynje" is applied to a "system" of cold weather clothing, whereas it applies strictly to a type of vest only ; Barrack Synopsis has a wider distribution than that suggested on page 75, and so on. Furthermore, the rapid passage of time has resulted in some references being already superseded, thus "Regs. MSA, 1938," paragraph 182 (page 370) has become "Regs. MSA, 1954," paragraph 151 ; "K.Rs. 1940" have become "Q.Rs. 1955" ; "AMD 1" has become "AMD 2" and *vice versa*, thus necessitating amendment to the chart facing page 14.

None of these minor points is of sufficient importance to mar the excellence of this comprehensive work, covering, as it does, every aspect of the soldier's environment in its widest sense. It can safely be predicted that the 1954 manual will be of the greatest value to R.A.M.C. officers for a long time to come, and indeed, has much to commend it to a very much wider circle of readers.

R. A. S.

HISTORY OF THE SECOND WORLD WAR : The Army Medical Services—Administration. Volume II, edited by F. A. E. Crew. H.M.S.O. 1955. Pp. 564 + xxiii. Illustrated.

Because the word "Administration" is repugnant to some specialists in the Corps it is as well to assure them not to be misled by this title. The volume in fact records the problems and achievements of the various specialties (other than Medicine and Surgery) during the war years.

Although generalship can often win a battle unaided, the pages of history show over and over again that what determines the outcome of a campaign is nearly always Preventive Medicine. It is only in war histories that the importance of Preventive Medicine in relation to other specialist medical services is ever properly assessed.

In times of peace the surgeon and physician are usually accorded a status superior to that of their other professional colleagues. In war, however, the surgeon deals with little more than the small proportion of soldiers who become battle casualties together with the almost equal number who become casualties from the occupational hazards of soldiering—a lot of them incurred on the sports field.

The physician in a theatre where health discipline is good is concerned with even fewer. Both are essential to morale, but neither is a decisive factor in total war.

That branch of the Army Medical Services which in war concerns every single soldier, no matter what his rank or military occupation, is the Army Health Service. Accordingly it is not surprising that half this volume is given over to an account of the achievements of the Army Hygiene Service (as it was then called).

The pages dealing with army health organization, supplies, environmental hygiene, rehabilitation and recategorization and diseases of military importance should be studied by every officer in the Corps, for they are the concern of all,

no matter how narrowly their field of vision may presently be restricted by the blinkers of specialization.

In seeking to stress the overriding importance of Army Health in war, no attempt to belittle the achievements of the other branches of the Corps is intended. Chapters 6 and 7 record the fine work of the Army Pathology Service, particularly in the field of transfusion.

The chapter on the Army Psychiatric Service is factual and agreeably devoid of verbosity and jargon. Other material in this volume is concerned with the Nursing, Dental, Ophthalmic and Radiological services. The editor also contributes a short chapter on his own Directorate of Medical Research.

The volume will chiefly be used by historians and administrators as a work of reference and it would, accordingly, have benefited from a fuller index with better cross-referencing.

Illustrations are limited, unimaginative and often repetitive ; the incinerator, for example, receives unwarrantably lavish pictorial treatment. Facts and figures abound but are not always presented to the best advantage. Tables are apt to become boring and there are other ways of making them arresting.

The price at £3 5s. is too high and places the book beyond the reach of many who would have benefited from it.

H. R. M.

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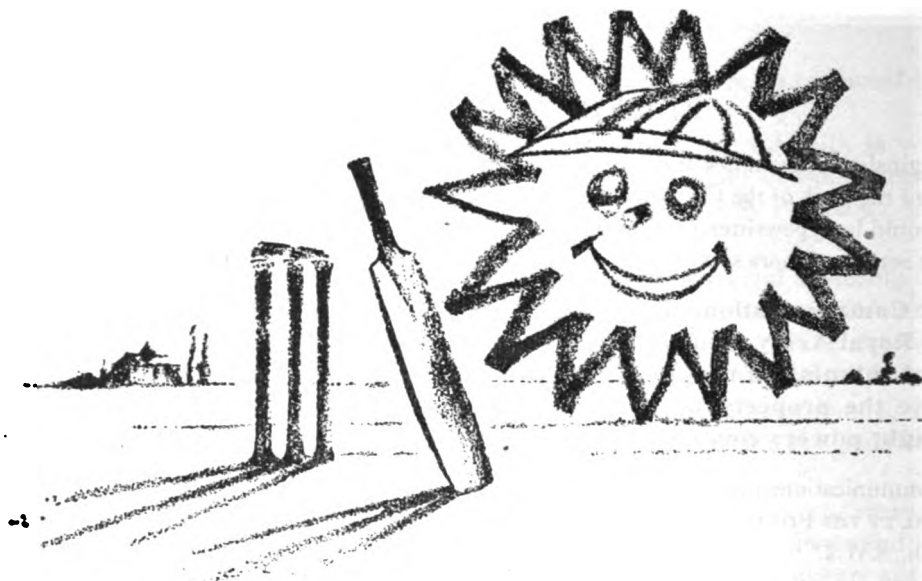
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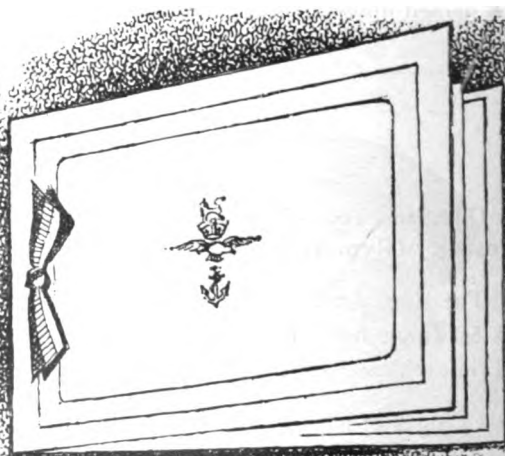
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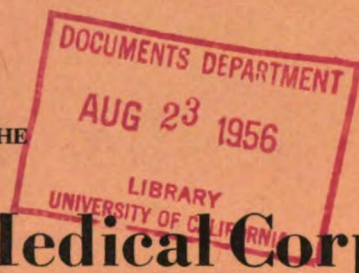
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## THE CAUSES AND CHARACTERISTICS OF CHRONIC BENIGN HEADACHE IN SOLDIERS

OBSERVATIONS ON HEADACHE NOT ATTRIBUTABLE TO SERIOUS  
PHYSICAL OR MENTAL DISEASE

BY

D. E. MARMION, M.A., M.D.(Camb.), M.R.C.P.

*Major, Royal Army Medical Corps (Retired)*

HEADACHE is a symptom ubiquitous in both civil and military medical practice, and is a common and troublesome problem for the regimental medical officer and the medical specialist. No apology is therefore needed for an attempt to examine the subject from the standpoint of the military physician.

A proper comprehension of the causes and characteristics of headache is impossible without some knowledge of the relevant anatomy and physiology, and as much of this is barely touched upon in current teaching in this country it will be necessary to summarize it.

### THE ANATOMY AND PHYSIOLOGY OF HEADACHE

Headache is essentially pain in the head, and pain may be "felt" in a part of the body for one or more of several reasons, which are summarized in Table 1. It is outside the scope of this article to consider in greater detail the physiology of pain, though some understanding of it is essential for the intelligent practice of medicine. A good brief account of aspects of it relevant to the present topic will be found in Fletcher's *Medical Disorders of the Locomotor System* (Fletcher, 1951).

Not all the structures of the head and neck are pain-sensitive. Outside the



cranial cavity, the skin, subcutaneous tissues, arteries, most nerves, muscles, tendons, aponeuroses, the eye and orbital contents, the mucous membranes of the oro-nasal cavities, the teeth and the jaws are in varying degrees pain-sensitive; the superficial veins, the cranial bones and diploe are insensitive or nearly so.

Within the cranial cavity the dural floors of the anterior and posterior fossæ, the dural venous sinuses and their larger tributaries, the arteries at the base of the brain, their larger branches, the meningeal arteries and the dura in their immediate vicinity, and some cranial nerves (V, VII, IX, X, XII) are pain-sensitive. The rest of the dura, the pia-archnoid, the smaller intracranial vessels, the ependyma and choroid plexuses, the parenchyma of the brain and the other cranial nerves are insensitive.

Supratentorial structures are innervated by the trigeminal nerve, and pain arising in them is referred to various sites in the anterior half of the head. Infratentorial structures are innervated by the last four cranial nerves and the first three cervical, and pain from them is referred to the posterior half of the head, the subocciput and the upper part of the neck. The exact sites of reference from many intracranial and extracranial situations have been worked out experimentally with great ingenuity by Wolff (1948) and his colleagues, and other workers, but for a variety of reasons much of this information is of limited value to the clinician.

The forms of stimulation that give rise to pain in extracranial structures are in general familiar enough to require no special mention, except to draw attention to the importance and peculiarities of the arteries and muscles, which will receive detailed attention later. Within the cranium distortion is the main pain-producing stimulus. Traction upon large vessels and sensitive dura, or over-distension or excessive pulsation of large arteries are examples. Inflammation, as in meningitis, and chemical irritation by blood or air introduced into the sub-arachnoid space, may also cause pain; raised or lowered intracranial pressure of itself does not, except in so far as it causes or permits distortion, as in the headache following lumbar puncture (Pickering, 1949). This explains the well-known fact that it is possible to have greatly increased intracranial pressure without headache.

We must now proceed to consider more carefully the principal mechanisms involved in the production of benign headache.

### *Vascular headache*

Overdilatation or excessive pulsation of intracranial or extracranial arteries is by far the commonest cause of headache (Pickering, *loc. cit.*). The "ordinary" headache of universal experience, whether from emotional causes, acute infection, a blow on the head or alcoholic excess, is for the most part and in most cases the result of excessive pulsation of cranial arteries, especially those within the cranial cavity; though the exact mechanism is obscure, it is clear that somehow there is disproportion between the intra-arterial blood-pressure and the pressure of the extra-arterial supporting structures (within the cranium this may be regarded as equivalent to the cerebrospinal fluid pressure), so that the relatively

unsupported arterial wall dilates and pulsates, causing pain by stretching the periarterial nerve plexus. This state of affairs can be reproduced experimentally by giving an injection of histamine. Hence this type of headache is sometimes called the histamine-type in contradistinction to the predominantly extracranial migraine-type referred to below. The resulting throbbing headache is immediately relieved by intrathecal injection of fluid to raise the cerebrospinal fluid pressure.

In migraine and arterial hypertension, the extracranial arteries are especially affected, and it is common to see the superficial temporal arteries standing out and pulsating violently. Firm pressure on this artery in front of the auricle will relieve the pain (though not in the later stages when the vessel wall is also œdematous). But even in classical migraine the intracranial arteries are involved to some extent, and the distinction between intracranial (histamine-type) and extracranial (migraine-type) headache is by no means firm.

#### *Headache from distortion of intracranial structures*

Space-occupying lesions, scars, adhesions and foreign bodies cause displacement and distortion of intracranial structures and hence may give rise to pain.

Table 1. *Pain mechanisms and pathways*

Mechanism	Physiology	Common Example	Headache Example
Direct	Pain felt at site of noxious stimulus.	Pain of cut finger felt at site of cut.	Temporal headache in temporal arteritis.
Referred	Pain referred from site of noxious stimulus to another site of similar segmental innervation.	Shoulder-tip pain in diaphragmatic pleurisy (both C4).	Supra-orbital headache in internal carotid aneurysm (both trigeminal).
Spread	Noxious stimulus causes excitation of sensory neurons, with "overflow" of excitation to other neurons in same and neighbouring segments, so that pain appears to spread to areas innervated by those neurons.	Crush injury of one finger causes pain in adjacent fingers, or even hand and arm (cervical and thoracic segments).	Toothache in upper jaw spreads to face and head if severe (trigeminal).
Muscular	Noxious stimulus causes reflex spasm of muscles innervated by involved segment: persistent spasm of muscles causes pain and tenderness.	Pain, tenderness and spasm of loin muscles in kidney disease (thoraco-lumbar segments).	Occipital headache in upper cervical arthritis (C2-3).
Neurogenic	Disorders of neural pathways and centres subserving pain sensation i.e. nerve, posterior root and ganglion, posterior horn, spino-thalamic tract, thalamus (and homologous cranial nerve structures and connexions).	Neuritis, herpetic neuralgia, thalamic syndrome, etc.	Occipital, supra-orbital, etc., neuralgia.
Psychogenic	Pain exists only in sensorium (i.e., is "suprasegmental") and has no physical basis at the periphery.	"Cardiac" pain in neuro-circulatory asthenia (effort syndrome).	Some types of hysterical headache.

Clinical examples are legion. Minimal displacement of structures consequent upon withdrawal of cerebrospinal fluid is probably also a factor in the pathogenesis of post-lumbar puncture headache. On more commonplace ground, the aggravation of almost any headache by jolting or violent shaking of the head is due to the inertia of the cranial contents causing them to drag upon their anchorages, whose pain-threshold is already lowered by pre-existing headache.

### *Neurogenic and neuralgic headache*

It is a common observation that a patient with a neuralgia of the head usually complains of "pain in the head" rather than "headache." In fact neuralgic pain is different from the familiar, if indescribable, pain of headache, even though the two may on occasion coexist, as when neuralgia causes secondary muscle spasm and consequent muscular headache.

Neuralgia may occur in several cranial nerves (particularly V, VII, and IX) and the cervical nerves, and possibly in association with some of the ganglia such as the geniculate and sphenopalatine. But in most cases neuralgia or neuritis of these nerves causes faceache, neckache, earache, and so on rather than headache.

For the sake of completeness we may here mention other forms of neurogenic pain such as those due to lesions involving the spino-thalamic tracts and the thalamus, though as causes of headache they are of little importance.

### *Headache of muscular origin*

Lewis (1942) showed that any muscle maintained in spasm eventually becomes painful and tender, and those about the head and neck are no exceptions. The spasm may be due to causes within the muscle itself (*e.g.*, fibrositis), its lower motor neuron (irritation of the nerve, tetanus), or the higher centres (emotional tension, or maintenance of an awkward posture); or it may be secondary or reflex, due to a noxious stimulus in the area whose segmental innervation is the same as that of the muscle. Familiar examples of secondary or reflex muscle spasm are the fixation of a painful joint, or the rigidity of the abdominal wall over an area of peritonitis. Similar spasm with pain and tenderness occur in the course of any headache, especially if long-continued, a common example being the spread of a migrainous headache to the occiput and down the back of the neck, even into the shoulder. Part of the headache of sinusitis, eyestrain, dental disease, and that following trauma to the head is muscular in origin, and it is clinically important to realize this because the muscular component of a headache can often be relieved quite simply even when the underlying cause proves resistant to treatment.

## CLINICAL PATTERNS OF HEADACHE

With some knowledge of the mechanisms by which headache is produced, we can now proceed to examine some common patterns of headache as manifested by patients who have this symptom unrelated to serious disease. Vascular headaches are the commonest, and we will first consider the classical vascular headache syndrome known as migraine.

### *Migraine*

The syndrome of hemicranial headache, preceded by visual disturbance and accompanied by gastric upset and prostration, with a tendency to run in families, was called by Galen *hemicrania*, which has become corrupted to *migraine*. Semantic abuse has even exceeded etymological corruption, and the word is all too often used today for any severe headache whether or not it fits the well-defined syndrome which inspired it.

In classical migraine there is a unilateral headache which may become bilateral as the attack wears on, and it is seldom on the same side on every occasion (should it be so it raises the suspicion of an organic basis such as an aneurysm or angioma). It is preceded by an aura which is commonly visual, for example a field defect, fortification spectra or flashes of light, and it is accompanied by photophobia, prostration, nausea and vomiting, and intense misery. There may be a family history of migraine or at least of severe headaches, and the patient may have suffered from "bilious attacks" or acidotic vomiting in childhood. Anxiety, stress or emotional unrest or overwork increase the frequency of attacks, as may a hot climate, and they may be precipitated by specific emotional stimuli, by menstruation, and by many agencies which in non-migrainous subjects would occasion non-specific vascular headaches, such as eyestrain, a head injury, or alcoholic excess; rarely there appears to be an allergic basis.

The onset is usually in adolescence but may be in childhood or later in life. After reaching a climax in young adult life, the condition tends to regress slowly with advancing years, especially in men. In women the menopause may bring cessation, temporary aggravation, or a change in the character of symptoms. Pregnancy often brings an increase in severity at first, followed by relief.

The attack varies greatly in severity: at its worst it may be totally incapacitating, the patient being able only to crawl to a quiet place and sleep it off. Alvarez (1943) says graphically, "One look at the dejected, apathetic and utterly miserable woman, and I know that only migraine or perhaps sea-sickness could produce such a picture and not kill the victim." The attack may last from two or three hours to as many days or more, but most often does not outlast the day of its commencement, passing off with sleep or leaving merely a "hang-over" the following day. Sometimes a bout of vomiting brings relief of the headache. It is not uncommon for a patient to have occasional long or severe headaches interspersed with more frequent milder ones.

Within the syndrome there is much scope for variety. The aura may be other than visual; for instance, somatic (paræsthesiæ), autonomic (vasomotor changes, epigastric sensations), motor (paresis), aphasic, psychomotor, etc. It may be preceded by a variable period of prodromata such as depression or elation. Sometimes the aura is absent, or occurs at the same time as the headache. The headache may be bilateral from the start, or replaced by neckache, faceache, or abdominal pain. Nausea or vomiting may be slight or absent, or may, on the other hand, occupy the centre of the stage at the expense of other features (so that the lay term "sick headache" becomes especially apt.) Flushing, blanching, vertigo and syncope are common accompaniments, and as there is water-

retention during the attack there is often a noticeable diuresis at the end of it.

The aura of migraine is presumed to be caused by local vasoconstriction of branches of the internal carotid artery. It may persist into or even outlast the headache, and rarely may remain permanently, probably owing to thrombosis of a constricted artery. Cases of migraine with gross neurological abnormalities such as ophthalmoplegia at any stage in their development should be suspected of having an organic basis.

Most authors state that migraine is commoner in females than in males, and in the intelligent and sensitive than in the dull and stolid; but Kinnear Wilson (1940) quotes extensive statistics which suggest that it afflicts about equally all sorts and conditions of both sexes. Much stress has been placed in recent years, especially in the United States, on the association of migraine with an obsessional, perfectionist, self-critical and uncompromising temperament, and there is little doubt that the "migraine personality" is a reality; nevertheless migraine is also very common in those whose temperaments are very different.

Over four out of five cases of migraine respond symptomatically to treatment with ergot derivatives. Ergotamine tartrate, 1-5 mg., is given sublingually at the earliest possible moment during the attack, preferably during the aura; the action may be potentiated by caffeine citrate orally, 100 mg. for each 1 mg. of ergotamine. Resistant cases may be helped by sodium amytal,  $\frac{1}{2}$  gr., codeine phosphate,  $\frac{1}{2}$ -1 gr., or compound codeine tablets in addition; or ergotamine tartrate, 0.5-1 mg., may be given subcutaneously. Dehydroergotamine may also be given by injection to those who are intolerant of ergotamine.

Cases failing to respond to ergot derivatives will sometimes gain relief from other drugs acting on the vasomotor system, such as carbachol, neostigmine, nitrites, priscol, nicotinic acid, inhalation of carbon dioxide, etc. Details of the use of ergot derivatives and many other drugs will be found in the works of Friedman (1951) and Wolff (1948).

Attempts to reduce the frequency of attacks other than by adjustments in the ways of living and thinking of the patient are usually unsuccessful, though sedation may tide over an emotional crisis or period of tension, and there are a few reports of the routine prophylactic use of dehydroergotamine, such as that of Dalsgaard-Nielsen (1950).

#### *Syndromes of the external carotid artery and its branches*

A number of uncommon syndromes of unilateral facial or cranial pain, usually with local vasomotor or secretomotor disturbances, have been described, such as Horton's cephalalgia (Horton, 1940) (paroxysmal orbital headache of brief duration but frequently repeated, with marked ipsilateral vasomotor changes, lacrimation, nasal congestion, etc.) and Sluder's lower-half headache (referred to later). There is little doubt that Wolff (1948) is correct in stating that all these syndromes are closely interrelated and are due to disturbances of vasomotor control within the distribution of the branches of the external carotid artery. They are apt to be confused with migraine or with trigeminal neuralgia; but there is neither aura nor gastric disturbance, nor is there a true trigger area

as in *tic douloureux*. Sufferers quite often give a history of allergy or of long-standing sinus trouble, and physical allergy (where the "allergen" is a physical stimulus such as a change in temperature acting upon, for instance, a sensitive nasal mucosa) seems to be a fairly common precipitating factor. Treatment is apt to be difficult, because the attacks are often of rapid onset and fairly brief duration, although the pain may be very severe. Ergotamine is sometimes effective, and antihistaminics may reduce the frequency of attacks in some cases.

#### *Non-specific vascular headaches.*

These form the majority of the "ordinary" headaches of everyday life, and detailed description is unnecessary. The greater number are of the so-called histamine-type, but others resemble migraine more or less, and the borderline between the two is vague and arbitrary. Nevertheless, there are sounder reasons than mere pedantry for restricting the term migraine to the classical syndrome, for it is the experience of many physicians that the more closely a patient's symptoms resemble migraine, the more likely are they to respond to ergotamine therapy.

Non-specific vascular headaches may be provoked in any person by sufficiently strong stimuli, for example an acute infection, a blow on the head, or an injection of histamine. Most normal persons suffer an occasional such headache from a variety of causes, including anxiety, fatigue, hunger, constipation or a hot and stuffy atmosphere ; whilst a few are constitutionally prone to headache and suffer the symptom in response to minor or even quite undiscernible stimuli. A detailed history will usually disclose the factors concerned, and hence suggest lines of prevention and treatment.

Specific drug therapy is usually disappointing, though the remedies used for migraine are sometimes successful. The best hope lies in prevention by management and psychotherapy, along with symptomatic treatment of such headaches as still occur by common analgesics, the best combination probably being aspirin, phenacetin, caffeine and butobarbitone.

#### *Vasomotor instability*

All vascular headaches of the kinds already discussed are examples of localized vasomotor instability, and it is not therefore surprising that headache forms a prominent feature in the syndrome of general vasomotor instability. This very common condition is curiously neglected. In the army (Carter, 1950) it is seen chiefly in young men of slender build with hypotonic musculature and poor posture, apt to flush and sweat easily, intolerant of extremes of temperature, and subject to syncope and headaches. The headaches are of any vascular pattern, including migraine, and are especially provoked by excitement, mental stress, exertion, heat fatigue, changes in posture and prolonged standing. Postural faintness on rising from bed is common, and may be accompanied by headache ; fainting while washing in the morning is a characteristic story. When faintness is associated with exertion it usually occurs just after rather than during strenuous effort ; for instance, during a brief rest in the course of physical training, or after a sprint.

In a given case either headache or fainting may predominate ; in different patients, or on different occasions in the same patient, headache may precede, accompany or follow faintness. Syncope is almost always preceded for a few seconds or longer by sweating, buzzing in the ears, vertigo, dimness of vision, spots before the eyes, nausea, or other characteristic subjective sensations ; frequently these prodromata may occur without syncope, especially if the subject takes heed of the warning and lies or sits down. Rarely prodromata appear to be absent, making the differential diagnosis from akinetic epilepsy difficult. There may be evidence of general autonomic instability such as hyperidrosis, bronchospasm or frequent micturition, and the incidence of allergy also appears to be high in these subjects.

The syndrome is exceedingly common in young soldiers. It may be associated with an anxiety state, a history of a significant head injury, chronic otitis media, convalescence from an illness, or first going to a hot climate (where it may appear in exaggerated form due to increased cutaneous vasodilatation and superadded salt deficiency). Though it is occasionally seen in young men of robust physique and active habits, it often seems to be an expression of what Alvarez (1943) has aptly termed "constitutional inadequacy." However, the syndrome is less common in older men, and presumably most young sufferers "grow out of it"; indeed, army experience suggests that it is a common and almost specific disorder of late adolescence.

The best treatment is a full conditioning course at an appropriate centre or, failing this, firm reassurance and a course of exercises designed to improve muscle tone, posture, and venous return. Drugs such as ephedrine, amphetamine and caffeine have a very limited usefulness, but ergotamine on waking in the morning often prevents early-morning headache. A change of employment may be necessary, because these young men cannot tolerate hot cookhouses or long hours on parade, and some must be forbidden to drive, handle firearms, and go to hot climates ; but most will make a satisfactory recovery in a few weeks or months if handled properly.

### *Muscular headaches*

Secondary muscular headache due to spasm in the vicinity of a painful lesion is exceedingly common and often present as a component of any kind of severe head pain, such as that of sinusitis, earache, toothache, occipital lymphadenitis, and headache proper. In such conditions the muscular ache may occasionally precede, overshadow or outlast the local pain of the causative lesion, leading to difficulties in diagnosis.

Primary muscular headache is rather less common than secondary, the form most frequently encountered in young men being fibrositic. Fibrositis is especially apt to occur in the trapezii, the nuchal muscles, the scalp muscles, and to a less extent the temporal and sternomastoid muscles. It gives rise to aching pain of appropriate distribution associated with neck stiffness and perhaps torticollis. It is worse in cold, damp weather, and when the patient is tired, in poor health or suffering from a chill or some other infection. It is worse on rising



in the morning and improved with the day's activity, but interferes with getting to sleep at night because of a curiously vague but distressing ache of low intensity that commences after a short time in any one position. As would be expected, there is often evidence of fibrositis elsewhere than in the head and neck.

On examination, tender nodules are felt in the affected muscles, and pressure on some of these will usually evoke a spreading headache or neckache. Infiltration of such trigger-points with procaine solution gives complete though not always permanent relief. Treatment by heat (especially short-wave diathermy), massage and active exercises gives excellent results, but fibrositis is difficult to eradicate and the patient should be warned that recurrence is likely but will respond to a further course of treatment.

Muscular headache of postural origin is usually occipital and is seen in typists, draughtsmen, microscopists, learner-drivers and aircraft-spotters, among others. There is very often coexistent fibrositis, and emotional tension and eyestrain may be contributory factors; in fact, it is preferable to designate most of these headaches as "occupational" rather than strictly "postural."

Muscular headache is usually characterized by persistence and relatively low intensity, but trauma to the neck muscles (such as a nuchal tear due to hyperflexion) may cause headache of acute onset and extreme severity. As it is accompanied by nuchal spasm it may mimic subarachnoid hæmorrhage (Marmion, 1954).

Other varieties of muscular headache, such as those due to emotional tension and to the effects of head injury, will be considered later.

#### PROXIMATE AND ULTIMATE CAUSES OF HEADACHE: PSYCHOLOGICAL FACTORS

We have so far considered chiefly the physiological processes which produce headache—the proximate causes of the symptom. But to the physician this is only a part of the story, for prevention depends upon discovering the ultimate cause. In the majority of patients presenting with benign headache this will lie wholly or partly in their mental and emotional life, and it is with this that we must now concern ourselves.

##### *Psychogenic headache*

Headache in young men is most often a manifestation of stress, a symptom indicating that the man in question is finding difficulty in adapting himself to his environment. Furthermore, it is usually a truly psychosomatic symptom, inasmuch as its origin is psychic whilst the means by which it is produced are physiological or somatic.

True psychosomatic disorders are perversions of the body's physiology, or the results of such perversions, and therein differ from the conversion symptoms of hysteria, whose proximate cause is entirely mental. The former have been described as *physiogenic* to differentiate them from the latter which are in the strict sense *psychogenic*. The vital point is that a psychosomatic (physiogenic) headache is a *real* pain perceived at the periphery by the usual sensory apparatus

and conveyed to the sensorium *via* the normal neurological paths. It is not in any sense imaginary or even—to make a somewhat subtle distinction—*imagined* (in the sense of existing only in the sensorium, as in the case of a conversion headache). It may be vascular or muscular or mixed, and the appropriate physical characteristics and signs will always be present, however deeply buried under a “psychogenic overlay.”

The commonest psychosomatic headache is that associated with anxiety or emotional tension, and is therefore called a tension headache ; it is sometimes said to be purely muscular in origin, but in fact a typically vascular headache can occur under identical circumstances. Less common is the relaxation headache, occurring after a stressful episode rather than before or during it, for instance after the day's work or at the week-end. Even in those not unduly prone to headache it is not rare following such powerful provocation as an important interview, an examination, or a battle. Pressor headaches of emotional origin are uncommon, but there is a specifically military headache syndrome of combined emotional and exertional origin which is not without interest. It consists of a headache accompanying the shouting of orders on the parade-ground, and in the author's experience is a by no means rare occupational disease confined to drill-instructors.

It is important to appreciate that migraine, orthostatic headache, and other more or less specific patterns of headache may be partly or entirely emotionally conditioned. Thus a headache that is, descriptively speaking, classically migrainous may in its time-relationships be a typical relaxation-headache.

Muscular tension headaches have been mentioned. The generally raised muscle tone of emotional tension is familiar, and has been well demonstrated electromyographically by Sainsbury and Gibson (1954), who have also recorded increased electrical activity of the scalp muscles coinciding with the onset of typical tension headache. Paroxysmal vascular headaches of emotional origin frequently provoke a secondary muscular component which may provide an almost permanent background of dull aching upon which the paroxysms are superimposed more or less frequently.

The conversion headache of hysteria referred to above, is present in the sensorium only and has no physical foundation at the periphery. It tends to be atypical, inconsistent, even bizarre. There are no accompanying physical signs such as arterial pulsation or muscular spasm. It responds poorly to analgesics, and is usually accompanied by other hysterical symptoms or at least evidence of an hysterical personality. But it must be emphasized that a truly psychosomatic (physiogenic) headache is as common in hysteria as is the conversion type, and not infrequently the two are inextricably interwoven.

Headache is a common symptom in depression, obsessional states, and the psychoses ; an occasional early schizophrenic may complain solely of headache which is apt to be attributed to an anxiety state until further symptoms or more thorough examination reveal the fundamental derangement of mental processes. Though the general physician must be on the watch for such cases, detailed consideration of them falls outside the scope of this article.

*The background of psychosomatic headache in the army*

The young man's introduction to army life is a period of considerable mental and physical stress, especially to those who have never before lived away from home, and psychosomatic disorders are correspondingly common. The symptomatology is varied and includes headache, fainting, neuro-circulatory asthenia, asthma, dyspepsia, bowel disorders, skin diseases, backache and frank neurosis. Precisely what dictates that this man will have headache and that man neuro-dermatitis is far from clear, but sometimes it is possible to see in psychosomatic symptoms a consequence, or merely an echo, of past events. A boy who has had three or four attacks of migraine a year since puberty now has that number in a month or even in a week; another not previously subject to headache now follows his mother's example and becomes, as she probably expresses it, "a martyr to them." An occasional trivial headache the legacy of a past head injury too often becomes an incapacitating disability when barrack-room and barrack-square replace more familiar and comfortable environment, or the aggravation may be delayed until the prospect of overseas service looms ahead.

A fortuitous trivial head injury or the febrile headache of an acute infection may precipitate chronic headache; but often enough it comes out of the blue, for headache is a socially acceptable disability carrying no stigma and fairly sure of evoking sympathy. Indeed, headache is a commonplace excuse for avoiding unwanted social commitments, and many a suggestible person can "will" himself (or more usually herself) into a headache *pro re nata*, so that the distinction between malingering and hysteria becomes blurred or non-existent (a disconcertingly frequent occurrence in military medicine). And in this connection it must not be forgotten, as the late Sir Hugh Cairns (1942) has observed, that "It is one thing to have a headache: it is quite another to complain of it."

In the nature of things the stresses that cause headache in older men differ from those that afflict the young soldier; family and financial troubles, too much work or responsibility, real or imagined ill-health, the prospect of retiring with inadequate financial means, and simply being a square peg in a round hole. Anyone familiar with service life today need not be reminded of the difficulties and frustrations, the separations and financial stringencies, that affect the majority in greater or less degree. Most men and women survive the slings and arrows without serious harm; some produce frank neuroses, euphemistically called "nervous breakdowns"; many more manifest their stress in psychosomatic disorders such as duodenal ulceration, hypertension, asthma, skin disorders, backache and headache. This last group especially contains many persons of great value to the army and to society, men of high intelligence, initiative and integrity, whose symptoms are in no small measure the result of their uncompromising sense of duty and the frustration this gives rise to in an imperfect world; much can be done to help them by a wise doctor.

*Post-traumatic headache*

The interplay of physical and mental factors is nowhere better seen than in the after-effects of a head injury. After all except the most trivial head injuries

and operations, headache for a few hours or days is to be expected, but if it persists it constitutes a manifestation of the post-traumatic syndrome, which also includes vertigo, fainting, impaired concentration, memory and intellect and more or less of the symptoms of chronic anxiety.

Although some authorities (McConnell, 1953) consider that the syndrome is often, perhaps always, caused by an intracranial hæmatoma or loculated fluid, the more generally accepted view is that usually there is no such structural abnormality.

Wolff (1948) and his colleagues have demonstrated three sorts of post-traumatic headache, two muscular and one vascular. There is a persistent generalized muscular ache or feeling of constriction, accentuated by firm palpation of the larger pericranial muscle masses; a similar ache restricted to the vicinity of the injury (or scar, if present), with marked local tenderness, and apt to merge from time to time into a generalized muscular headache; and a periodic paroxysmal vascular headache, more or less migrainous in character, precipitated by emotion, exertion, postural changes, noise, and the like.

Muscular headaches are accompanied by generalized and localized muscular tension respectively. This can be demonstrated electromyographically, and is considered to be partly organic and partly psychological in origin. The causation of this is obscure. What is clear is that the psychological component of the syndrome is closely akin to an anxiety state, and requires treatment along the same lines. Since the muscular headaches are often fairly easily relieved by methods already described, they may provide an opportunity for the physician to gain the confidence of the patient, which is a necessary first step in treatment of the syndrome as a whole.

The vascular headache, though much more severe than the muscular ones, is usually short-lived, and may in fact be superimposed on the persistent dull muscular pain. Symptomatically it sometimes responds to treatment as for migraine.

In the absence of demonstrable organic cerebral damage the post-traumatic syndrome in the keen, fit and stable soldier may usually be nipped in the bud by sensible management reinforced by reassurance and symptomatic treatment. But in the unenthusiastic conscript or the social misfit who has drifted into the army *faute de mieux* the problem is altogether more formidable. Such patients may with difficulty be prevented from developing the syndrome, but once it is established (and this happens all too readily) its cure is unlikely so long as the patient is retained in the service. To the uneducated, even to many educated people, the head is not merely the seat of the brain and the mind but is symbolic of the Self, and hence endowed with mystical qualities. It is commonly believed to be fantastically vulnerable and the brain itself fragile as thistledown, so that the knowledge of an indisputable physical insult to it acts as a powerful bar to the acceptance of reassurance. But despite these and other difficulties, patience and perseverance in management along the lines indicated by Russell (1942) are sometimes rewarded.

Much of what has been said about the clinical features and management of

post-traumatic headache applies also to the less common headaches following meningitis, encephalitis and cerebral vascular accidents.

### CHRONIC HEADACHE DUE TO MINOR ORGANIC DISEASE

We are not concerned here with headache due to major organic disease such as hypertension or intracranial tumour, but it would be unrealistic to ignore the minor ailments of the eyes, nose, sinuses, teeth and neck, which are frequently responsible for headache.

#### *The eyes*

Glaucoma, iritis, optic neuritis, choroiditis, orbital tumours, and other serious diseases of the eyes cause headache among other symptoms, but they usually produce obvious signs as well and therefore do not enter greatly into the differential diagnosis of headache as such. Most of the minor disorders which cause headache and little or nothing else form an ill-defined group collectively referred to as eyestrain.

The symptoms of eyestrain include ocular tiredness and aching, blurring of vision, frowning, lachrymation and conjunctival suffusion, and headache in various regions including frontal, temporal and occipital. These tend to be associated with reading or other intensive use of the eyes, especially if unfamiliar or unaccustomed. According to Riddell (1954), the commonest cause in young people is uncorrected long-sightedness. In general, eyestrain is usually related to fatigue of the ocular musculature from excessive, unbalanced or unaccustomed action, in turn brought about by abnormalities of structure or function such as anisophoria, errors of refraction, or rarely aniseikonia (inequality of the retinal images in the two eyes). A further important cause is simply prolonged use of the eyes with no significant abnormality. As Duke-Elder (1949) says in a masterly account of the subject, "The manifestations of eyestrain depend partly on the uses to which the eyes are put, partly on the efficiency of the visual apparatus and partly on the capacity to the individual to withstand sustained effort." Not only does intensive use of normal eyes produce strain eventually, but activities that involve it tend to be headache-producing through emotional tension, intense concentration, and unphysiological posture. Therefore, even if the eyes are incriminated as the main cause of headache, treatment will be incomplete and unsatisfactory without attention to the other factors involved. To quote Duke Elder again, "Optical efficiency is necessary, but treatment should never degenerate into a routine correction of the optical defect with spectacles."

Headache from exposure to intense sunlight is fairly common in the tropics and snowfields, especially on high glaciers. Though it is often said to have its origin in pupillary spasm, it may also be related to the intense frowning and screwing-up of the eyes which is also present.

#### *The nose and sinuses*

A very small proportion of the headaches attributed by doctors and patients alike to sinusitis is in fact due to sinus disease. Proetz (1943) estimated that less than 5 per cent. of headaches are so caused.

In acute sinusitis there is usually headache, but the picture is dominated by the upper respiratory infection. In chronic sinusitis, too, there are nearly always indications of the seat of the trouble in the form of easily detectable clinical or radiological signs. This is no place to enter into the *minutiæ* of the diagnosis of sinus disease, but it is worth mentioning that the maxillary antrum is by far the most commonly infected sinus, and that the frontal sinus is seldom, the other sinuses almost never, infected in the presence of healthy maxillary antra. This is of help in diagnosis, because the maxillary antrum when diseased gives rise to pain below as well as above the orbit, and is anyway relatively easy to examine clinically and radiologically.

The headache or other pain of chronic sinusitis is of a dull aching quality, seldom very severe, and rapidly relieved by drainage of the offending sinus. The pain of maxillary sinusitis is chiefly zygomatic, orbital, and to a less extent frontal, and is associated with maxillary, upper dental and sometimes frontal tenderness. Frontal sinusitis causes pain in the distribution of the supra-orbital nerve. Sinus pain generally is notable for its punctual return at the same time each day. Precise knowledge of the areas of reference of pain from the various sinuses is of limited value in diagnosis because there is so often spread of pain as well as concomitant toxic vascular headache or muscle-spasm pain.

"Vacuum headache" (Sluder, 1918) is a disputed entity. It is said to be caused by obstruction of the nasofrontal duct by œdema or viscid secretion, followed by partial absorption of the air within the frontal sinus. It probably accounts for an occasional example of typical sinus pain without evidence of active sinusitis. Sluder (1908) also described "lower-half headache," often equated with sphenopalatine neuralgia. This consists of ocular, orbital zygomatic and low temporal pain of a peculiarly unpleasant character, with lachrymation, photophobia, rhinorrhœa and tenderness of the eyeball, and appears sometimes to be related to sinusitis or rhinitis.

Irritation of the nasal mucosa, apart from the sinuses, causes pain, usually a faccache but sometimes a frontal or orbital headache. It may be due to a cold, allergic rhinitis, a polyp, a displaced septum, or merely hot or cold air on a sensitive mucosa.

### *The ears*

Pain in the ears is felt as "earache," but true headache may occur by spread or from muscle-spasm, as well as from fever and toxæmia. Inflammation of a lymph gland lying against the sternomastoid muscle can cause spasm of the muscle and pain in the mastoid region which may give rise to the suspicion of mastoiditis.

### *The teeth and jaws*

Dental disorders occasionally cause puzzling headaches, which sometimes overshadow the local pain and cause diagnostic confusion. The site is usually the temporal region, and there is associated spasm of the temporalis muscle. Costen (1936) has described a syndrome, of which headache is a prominent

feature, due to malocclusion in the edentulous or those with ill-fitting dentures. Temporomandibular arthritis and parotitis sometimes present as temporal headache.

#### *The neck and cervical spine*

Occipital headache from disorders of the cervical spine is fairly often seen, common causes being osteoarthritis, spondylosis, and the effects of trauma. Fibrositis is the commonest soft-tissue condition to cause headache, but occipital lymphadenitis from any cause also produces muscle spasm and consequent pain. Even painful conditions of the shoulder can cause headache by the same mechanism.

### THE DIAGNOSIS OF HEADACHE

The more important benign headache syndromes and their causes, so far as we understand them, have now been briefly considered, and it remains to make a few remarks on diagnosis.

When a patient complains of headache he sets a threefold diagnostic problem which involves the answering of three questions : (1) Is this headache a symptom of serious physical or mental disease, or of minor local disease in the eyes, sinuses, etc.? If not, (2) what is the proximate cause, or mechanism by which pain is produced (vascular, muscular, etc.)? Finally, (3) what is the ultimate cause (constitutional predisposition, emotional tension, etc.)?

The most important serious organic diseases which cause chronic headache in the age-group with which the military physician is most concerned are intracranial space-occupying lesions and hypertension. Less important are chronic infections such as brucellosis, malaria, and tuberculosis ; barbiturate and other intoxications ; anæmia, uræmia and (in the tropics) salt deficiency. Headache is almost always accompanied by other prominent symptoms in epilepsy, hypoglycæmia, phæochromocytoma, neurosyphilis, and a wide variety of other diseases. The diagnosis or exclusion of such possibilities need not be dealt with here as they are adequately described in standard text-books.

The proximate cause or causes of a benign headache may be clear from the history and physical examination, provided that the head and neck are examined as thoroughly and methodically as the surgeon examines the abdomen of a patient with obscure abdominal pain. It is often helpful to examine the patient when he has a headache.

In the diagnosis of the ultimate cause (often a combination of causes, physical and psychological) the physical factors seldom present any great difficulty. It is the psychological investigation that takes time, patience and skill, and as the majority of the headaches of soldiers (and other people) are psychosomatic, it is by far the most important part of the interview. It is essential to learn what sort of a person the patient is, how intelligent, conscientious, candid, nervous, aggressive, and mature ; what are his problems, fears, hopes, difficulties, and how he reacts to them ; something of his family, his job, hobbies, recreations and interests ; his estimate of himself, and his attitude to his symptoms. With



a little practice much can be learned about a person in a few minutes' interview (though it is essential that it should be unhurried), and with this knowledge the patient's symptoms can be seen in their proper perspective as part of his life, and the relation between cause and effect is usually obvious.

It is of practical value to recognize three degrees in the psychological component of the ætiology of a headache, according to whether it is (1) insignificant or slight, and likely to clear up with the relief of physical symptoms ; (2) mild to moderately severe, making a significant or even predominant contribution, but fairly superficial and likely to be amenable to simple reassurance and psychotherapy of the sort that any physician can give ; or (3) paramount, the physical symptoms being merely expressions of a severe psychological disorder which will require expert psychiatric investigation and treatment.

The psychosomatic headaches of young soldiers are remarkably stereotyped. Thus the experienced military physician will recognize at once the immature recruit whose headaches accompany an anxiety about his "mum" which is merely a reflection of his own dependence upon her ; the youth with flabby muscles, pot-belly and hollow back who does not play games and whose life is punctuated by "blackouts," "dizzy spells" and headaches ; the village "tough" who volunteered for parachuting out of bravado and now regrets it, developing a persistent headache following a trivial bump on the head during training ; the officer or senior N.C.O. whose incompatibility with his immediate superior is the cause of his persistent tension headaches ; the classical migrainous subject whose perfectionism brooks no compromise and who consequently lives in a state of permanent headache-ridden frustration ; and the hopelessly inadequate man who has met every stress of life, from childhood through adolescence to what passes for manhood, with a psychosomatic protest of one sort or another.

### THE MANAGEMENT OF HEADACHE IN THE ARMY

The civilian who is a little "off colour" stays at home in bed or in an armchair for a day or two, but the soldier has no such limbo and must be either fit or sick. Consequently military medicine is much concerned with early disease, prolonged convalescence and trivial disorders. Minor disabilities like headache cause a disproportionate amount of trouble to all concerned, especially where there is insufficient understanding, confidence and mutual respect between the regimental authorities and medical services. Good liaison between the two will prevent unnecessary hospitalization and promote common-sense toleration of the weaknesses of the flesh. For instance, the recruit with frequent stress headaches must not be sent to hospital when all he needs is a few hours' bedded down, firm reassurance, and some aspirin ; admission to hospital will militate strongly against rapid recovery. On the other hand, the obsessional and conscientious chief clerk whose migraine necessitates an occasional day off duty will be made worse if threatened with the loss of his job or his rank on this account.

Soldiers with headache should only exceptionally be admitted to hospital, as this strongly reinforces the belief that the disability is serious ; it is unnecessary

to emphasize how difficult it often is to return a headache patient to duty after his stay in hospital. If he must be admitted for investigation he should be told beforehand how long this will take, and that he will be discharged at the end of this time (assuming that no serious disease is found) whether or not the headache is still present, treatment being commenced only on discharge from hospital. This scheme, firmly but tactfully applied, saves much mental trauma to both patient and doctor.

Most sufferers from chronic benign headache are victims of minor psychological disorder, and it is sometimes held that only psychological methods of investigation and treatment are effective, though the manifest absurdity of this contention will be clear to anyone who has himself experienced the efficacy of aspirin in relieving a tension or relaxation headache. Furthermore, the stresses that produce headache in soldiers and others are often transient, and symptomatic treatment helps the patient over a crisis until circumstances change or he learns to adapt himself to them. Symptomatic relief also increases well-being, self-confidence, and confidence in the doctor, and enables the common vicious circle of headache—anxiety—headache, to be broken.

Drugs therefore have a definite, logical and important part to play in the management of headache. The ergot derivatives have been briefly dealt with, and common analgesics mentioned ; there is no place for the use of habit-forming anodynes in the treatment of benign headache, and sedatives such as the barbiturates should be prescribed with more discretion than is sometimes shown (barbiturate headache as a complication of treatment is no rarity). Mephenesin, 0.5-1 g., three or four times daily is useful for obtaining muscular relaxation in fibrositis, traumatic lesions, and especially in psychological tension states. A vast number of other drugs are or have been used in the treatment of different forms of headache, but those mentioned above or previously in this article are by far the most important. Details of treatment will be found in the books by Friedman (1951) and Wolff (1948), amongst others.

Headache should seldom necessitate invaliding from the service, unless it is merely an expression of severe emotional instability or personality defect. The psychopathic personality may sometimes be rid of his headache by a therapeutic *tour de force*, but the victory is an empty one because some other psychosomatic or hysterical symptom almost always takes its place.

Soldiers with severe vascular headaches are often made worse by heat and may have to be placed in a non-tropical category. It must not be forgotten, furthermore, that a man subject to severe paroxysmal headaches under stress may be genuinely incapacitated by them, and he should not be allowed to occupy a key position in a combatant unit where he may be a menace to others as well as to himself.

In the management of such minor but important disorders as headache in the army much depends upon the skill, patience, local knowledge, resource and authority of the regimental medical officer. Lack of these qualities cannot be made good by any amount of technical virtuosity on the part of a hospital specialist. The management of minor maladies is, in fact, an aspect of man

management, a military art of which the regimental medical officer should be one of the most skilful exponents.

### CONCLUSION

Condensation of a large subject into a small compass must lead to omissions, generalizations, and dogmatic asseverations in the place of reasoned statements—all potential sources of error and misunderstanding. Therefore the reader whose interest has been stimulated is recommended to read the excellent work by Moench (1951), or for more succinct information, Kunkle & Wolff (1951). Despite the neglect it suffers, the topic is not without interest. As an exercise in pure clinical medicine the study of headache has few equals, requiring neither elaborate equipment nor complex techniques, but demanding a high standard of clinical observation which, to quote Wilfred Trotter (1930), "should be the source and reservoir of that flow of ideas which alone can maintain the fertility of the whole field of medical science."

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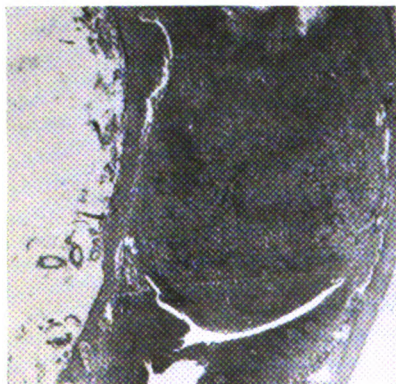


Fig. 1. Longitudinal section of the appendix showing a carcinoid tumour obstructing the lumen.  
H. & E.  $\times 5$ .

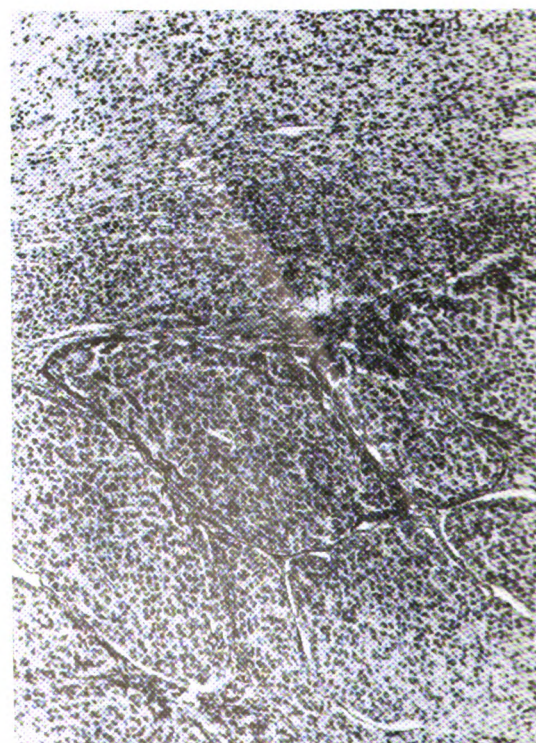


Fig. 2. Carcinoid tumour of appendix, showing compact groups of typical "carcinoid" cells and underlying inflammatory infiltration of submucosa and muscularis.  
H. & E.  $\times 90$ .

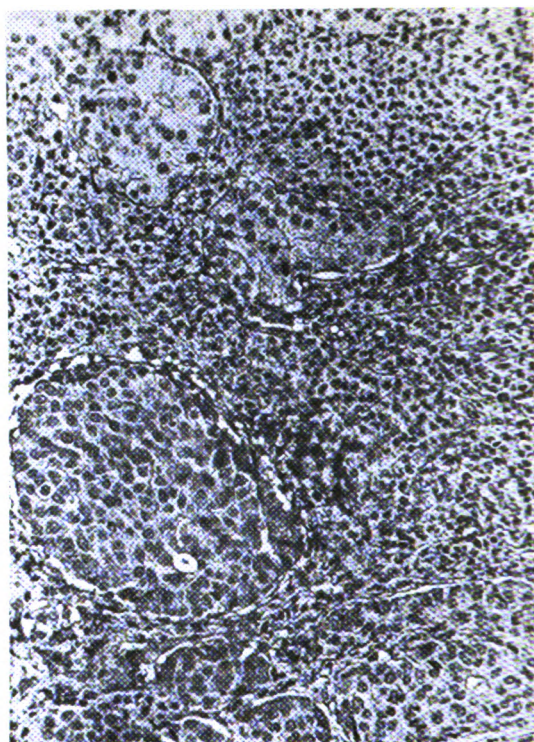


Fig. 3. Groups of carcinoid cells, some arranged compactly, others tending to form acinar structures. The tumour masses are surrounded by collections of polymorphonuclear leucocytes.  
H. & E.  $\times 165$ .

## CARCINOID TUMOURS

BY

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IN 723 consecutive appendicectomies carried out at the David Lewis Northern Hospital, each appendix was examined microscopically and six carcinoid tumours were encountered. During the same period (1948-1954) two cases of carcinoid growths of the small intestine and one case of a similar tumour arising in the pelvic colon were treated surgically.

### HISTORY

Merling in 1838 was the first to describe a case of a primary carcinoma arising in the appendix, and 50 years later Lubarsch pointed out the differences between this type of tumour and a true carcinoma, stressing that they did not metastasize, that the cells did not form a glandular pattern, and that cytologically they did not present the features of typical cancer cells. In extra-appendicular situations Lubarsch (1888) noticed that carcinoid tumours were frequently multiple. It was Obendorfer in 1907 who proposed to the German Pathological Society in Dresden that the name "Carcinoid" would be appropriately applied to these tumours, particularly in the appendix where the growth is rarely malignant in disposition.

### ORIGIN

Carcinoid tumours are thought to arise from the Kultschitzky cells that occur throughout the length of the intestinal tract. The appendix contains the largest numbers of these cells and, whereas in the small intestine they are common in the duodenum and the terminal ileum, they are relatively scarce in the large intestine. The Kultschitzky cell is of variable shape and form, though usually pear-shaped in outline. It lies in the superficial epithelium of a villus at the base of a crypt or in the wall of Brunner's glands. The cell consists of a spherical or ovoid nucleus surrounded by a cytoplasm which is faintly eosinophilic. Within the cytoplasm are vacuoles of lipid which impart to the tumour its yellowish colour. Characteristic of these cells are the argentaffin granules lying between the nucleus and the basement membrane. The granules fluoresce in ultra-violet light, stain with chromic acid and contain an enzyme-like substance which precipitates silver from solutions.

Whereas Masson (1928) regards the cells as an integral element of a widely dispersed endocrine ("Neurocrine") organ, Popoff (1939) believes the Kultschitzky cells are continuously elaborated in the adult from mucus-secreting cells. The presence of non-granular forms of the cells may well be due to the precursors of the argentaffin cells. Bunting (1904) suggested that carcinoid

tumours were carcinomata homologous to the basal cell carcinoma of the skin, and Obendorfer preferred to regard them as originating in misplaced pancreatic tissue situated in the intestinal wall.

### PHYSIOLOGY

5-Hydroxytryptamine has been demonstrated by Lembeck (1953) to be contained in large amounts by carcinoid tumours. It is usually associated with other physiologically active, though unidentifiable substances. More recently Erspamer (1954) has isolated 5-hydroxytryptamine in the enterochromaffin of the octopus. It is thought that this substance is important in gastro-intestinal function by actively stimulating peristalsis. Excessive amounts of this substance in the circulation will not only give signs of intestinal hurry in the form of diarrhoea, but will also give various associated vasomotor phenomena. During an attack of "flushing" in two patients suffering from malignant carcinoid tumours, Pernow & Waldenstrom (1954) have detected substances resembling 5-hydroxytryptamine (enteramine, serotonin) in the blood and urine.

### PATHOLOGY

Carcinoid tumours are usually small orange-yellow or greyish-yellow nodules lying in the mucous or submucous coats and, though firm in consistency, do not commonly ulcerate through the mucosa. They occur as sharply defined and circumscribed swellings, though sometimes the margins are ill defined and the tumours extend through to the subserosa. Occasionally a carcinoid may involve the whole circumference of the intestine. Whereas in the appendix the tumour is nearly always single, 70 per cent. being situated in the distal third, one-third of those arising in the small intestine are multiple.

The characteristic argentaffin cells may be arranged in clumps, nests or in rosettes and sometimes a pseudoglandular arrangement is seen. Mitotic figures are few and very scattered. These masses of cells are at first situated in the submucosal regions, but as the tumour cells spread and penetrate the muscle layer, they tend to lie in rows giving the appearance of cords. The stroma is variable and usually scanty, varying from a few loose fibres to a wide band of collagenous and hyaline connective tissue. Cellular infiltration of the stroma is never very marked, though groups of lymphocytes or eosinophilic leucocytes may appear.

### MALIGNANCY AND SPREAD

Dockerty & Ashburn (1943) insist that all carcinoid neoplasms are indeed malignant and it is as well to designate them as grade 1 adenocarcinomata (carcinoids), to suggest at once that they are universally malignant and of a specific cell origin.

Carcinoid tumours in the ileum and other parts of the intestine not infrequently run a more malignant course than when situated in the appendix. They are multiple in half the cases and in a third there are metastases present at the time of operation, whereas in the appendix only about 4 per cent. of the tumours metastasize. Raiford (1933) believes that this peculiarity of the appendix



is simply explained by the neoplasm being localized in a narrower part of the intestine and will give symptoms at an early stage. The commonest mode of spread is by the lymphatics to the lymph nodes, and transœlomically on to the peritoneum, but blood spread does occur rarely and when it does deposits are found in the liver. Ritchie & Stafford (1944) record a case with metastases in the spleen, uterus and both ovaries, and on microscopy clusters of cells were seen within the vascular lumens. Shaw (1925) has quoted a case of Callander's in which there was hæmatogenous spread to the liver. We can assume that, though the carcinoid is commonly less malignant than the carcinoma, in certain situations and under certain circumstances they can be very virulent and highly malignant, spreading rapidly through the blood stream.

#### CARCINOID OF THE APPENDIX

In 723 consecutive appendicectomies, six carcinoid tumours of the appendix have been removed (0.8 per cent.). In four of these cases the tumour has been situated in the tip. The remaining two were located towards the base of the appendix.

Tumours situated proximally in the appendix tend to encroach on the lumen and produce signs of obstructive appendicitis. In the two carcinoids located at the base of the appendix, one (Case No. 5) presented as a typical obstructive appendicitis, the other (Case No. 3) as a recurrent appendicitis. In the latter case there was much submucous inflammation on histological examination. The tumours in the tip (Cases No. 1, 2, 4 and 6) presented with vague pain in the right iliac fossa, and some tenderness in that region on palpation. In none of these cases were there any signs of inflammatory reaction in the remainder of the appendix.

It is interesting to surmise about the origin of the pain in carcinoid tumours. The cells are often closely juxtaposed to the fibres of Auerbach's submucous plexus. Masson considered them to arise on the basis of a "musculo-nervous complex of the mucosa." It may be, however, that the "pain" present in these cases is quite unrelated, and for the patient, fortuitous. The six cases of carcinoid tumour of the appendix which are quoted in this paper have been followed up to the present date and are well, without any symptoms.

#### CARCINOID OF THE SMALL INTESTINE

As already noted, carcinoid tumours of the small intestine tend to be of greater potential malignancy than those arising in the appendix, and to occur in a much older age group, as, for example, the two cases submitted to operation were elderly females aged 69 and 72 respectively (Cases No. 7 and 8). The first symptom is usually pain, which may or may not be associated with a watery diarrhœa. Later the growth causes a stenosis of the gut, giving the signs and symptoms of an intestinal obstruction. When the abdomen is palpated tenderness is commonly elicited over the tumour. Occult blood tests are usually negative, for the tumour rarely ulcerates through the mucosa.

The first case (No. 7) complained of attacks of abdominal pain, sickness and



diarrhœa on and off for the previous two and a half years, and was eventually admitted to hospital because of small intestinal obstruction. At operation three separate carcinoid tumours of the small intestine were found, one of which had produced stenosis. There was no evidence of metastases when the abdomen was explored. The second case (No. 8) complained of intermittent pain on the right side of the abdomen for two years, but with no disturbance of bowel action. Laparotomy disclosed a carcinoid tumour situated at the ileo-cæcal valve with metastases in the regional lymph nodes.

### CARCINOID OF THE COLON AND RECTUM

Rosser (1951) in his description of these tumours confirmed the findings of Stout (1942) by recognizing two types of carcinoid growths affecting the large intestine. In the first place there is the locally invasive type of growth which has the same benignity as when it occurs in the appendix, and secondly the wildly invasive tumours which may metastasize through the lymph or blood stream to an organ, or spread rapidly by local extension. The malignant potentialities of the latter type of tumour do not logically satisfy the term "carcinoid" as originally described by Obendorfer. Nor is Masson's designation of "argentaftin tumour" obeyed because these cells do not react with silver solutions. This has been explained by Stout as due to the absence, in the migrated cells, of an essential chemical, enteramine.

A case occurred in a single woman aged 75 (Case No. 9), who had suffered from "colitis" for many years, and had been passing large amounts of blood and mucus in her fæces. She was eventually admitted to hospital because of an intestinal obstruction, the cause of which was found to be an intussusception of the pelvic colon, with a carcinoid tumour situated at the apex of the intussusciptions. This was resected *en masse* in a Paul-Mikulicz manner. The colostomy was subsequently closed. She died just over one year later with multiple metastases.

### DISCUSSION

The incidence of carcinoid tumours of the appendix is variously stated, and the average figure is usually quoted at about 0.4 per cent. One of the largest series was recorded by Riemann (1918), who could only find 14 carcinoid tumours of the appendix in 13,151 appendicectomies. None of this series was carried out on consecutive appendicectomies and, though the number of cases at the Northern Hospital is relatively much smaller, the fact that the cases are consecutive would suggest that the incidence of these tumours is probably higher than is generally appreciated.

It is impossible to diagnose a carcinoid tumour of the appendix from the symptomatology, and even at operation the presence of the tumour may not be recognized. This would suggest that every appendix removed at operation should be subjected to a careful histological examination irrespective of whether it is acute (see accompanying microphotographs) or chronic in appearance. The routine microscopical inspection of operative specimens has enabled us to

demonstrate a carcinoid tumour arising in a Meckel's diverticulum on two occasions. The true nature of the pathology could not be recognized before the specimens were sectioned; macroscopical examination showed only a thickening in the wall of the diverticulum.

The correct diagnosis is of some importance in the follow-up of these cases, for if the case develops any further symptoms suggestive of a carcinoidosis, such as diarrhoea or intestinal obstruction, they should be submitted to an exploratory laparotomy. It is possible to effect a cure by removing peritoneal deposits, for Stewart & Taylor (1926) have described an appendicular carcinoid which subsequently gave rise to large deposits on the peritoneum. Removal of the appendicular and the peritoneal growths apparently have effected a cure, since the patient was still alive and well ten years later. The operation of choice is still a simple appendicectomy for a carcinoid tumour of the appendix in which there are no obvious metastases present.

### SUMMARY OF CASE REPORTS

1. MISS F. Age 37.

*History.* Abdominal pain on and off for five years, more on the right side for the past year. On examination, tenderness localized to McBurney's point.

*Operation:* 29.2.48. Laparotomy/appendicectomy.

*Pathologist's report.* There is an argentaphil tumour mainly of solid clumps with an attempt here and there at an adenoid pattern. It lies mainly in the muscle coat and extends to the serous layer.

*Follow-up.* 1953—Well with no symptoms.

2. MISS M. Age 20.

*History.* Pain in R.I.F. 15 months ago. Recent attack 10 weeks previously. Began high under the ribs and then moved to R.I.F. On examination, there was slight tenderness over McBurney's point.

*Operation:* 15.6.48. Retro-cæcal appendix.

*Pathologist's report.* There is an argentaphil tumour of the appendix. The main mass is in the submucosa, but extensions of the tumour occur in the vascular layer, through the serous layer.

*Follow-up.* 1954—Well with no symptoms.

3. MR. M. Age 51.

*History.* One year previously, generalized abdominal colic which settled in the R.I.F. Similar attack one month prior to admission. On examination, small tender mass in the R.I.F.

*Operation:* 18.8.48. Fixed retro-cæcal appendix.

*Pathologist's report.* Macroscopically a grossly thickened specimen, with a yellow tumour-like area about  $\frac{1}{2}$  inch long and  $\frac{3}{8}$  inch wide between the muscle and serous layers, about 1 inch from base of appendix. Microscopically there is much submucous inflammation. The muscle layers are disorientated, and thrown into a papilliferous arrangement under the submucosa.

*Follow-up.* 1954—Well with no symptoms.

## 4. MISS L. Age 18.

*History.* Twelve hours' abdominal colic localizing in the R.I.F. No previous pain.

*Operation:* 12.7.54. Retro-cæcal appendix.

*Pathologist's report.* At the tip of the appendix within the mucosa is a yellowish nodule the size of a millet seed. Section taken through this area shows that extending from the mucosa through the wall of the appendix is a neoplasm. The neoplastic cells are cubical with a round vesicular nucleus, and form solid clumps of cells, which are separated from one another by a variable amount of connective tissue.

*Follow-up.* 1954—Well with no symptoms.

## 5. MR. T. Age 25.

*History.* Colicky umbilical pain.

*Operation:* 16.8.53. Acute retro-cæcal appendicitis.

*Pathologist's report.* Obstructive type of acute appendicitis occasioned by a carcinoid tumour situated at the junction of the proximal and distal halves and completely obstructing the lumen.

*Follow-up.* 1954—Well with no symptoms.

## 6. MRS. W. Age 28.

*History.* Three months previously, attack of central abdominal pain finishing in the R.I.F. On examination, no tenderness.

*Operation:* 19.10.54. Retro-cæcal appendix.

*Pathologist's report:* There is a carcinoid tumour situated at the tip of the appendix.

*Follow-up.* 1954—Well with no symptoms.

## 7. MRS. T. Age 69.

*History.* Attacks of abdominal pain, sickness and diarrhœa for 2½ years. On examination, tenderness in the R.I.F.

*Operation:* 17.3.53. Resection of length of small intestine containing three carcinoid tumours. No metastases.

*Pathologist's report.* There are three separate carcinoid tumours of the small intestine. One of these is producing stenosis and is infiltrating through all layers of the gut. No involved lymph nodes were found.

*Follow-up.* 1954. Since the operation in 1953 the bowel action has always been frequent, varying from four to eight times daily. On examination, liver palpably enlarged. Vaginal examination: nodules felt within the pelvis.

## 8. MRS. Th. Age 72.

*History.* Lower abdominal pain mainly on the right side on and off for two years. On examination, tenderness in that region.

*Operation:* 26.10.53. Right hemicolectomy.

*Pathologist's report.* Carcinoid tumour of the ilco-cæcal valve, with metastatic deposits in the regional glands.

*Follow-up.* 1954—Well with no symptoms.

## 9. Miss I. Age 75.

*History.* Colitis with blood and mucus for many years. Admitted to hospital with intestinal obstruction.

**Operation:** 28.12.52. Intussusception of pelvic colon due to a carcinoid tumour. Paul-Mikulicz resection.

**Pathologist's report.** Carcinoma of the colon which is infiltrating through all layers of the bowel wall. The tumour cells occur in tiny clusters and moderate-sized clumps, sometimes giving a carcinoid pattern. Lymph nodes not involved. Unable to demonstrate argentaphil tendency in these cells.

**Follow-up.** Died 1953.

I wish to express my thanks to the surgeons of the Northern Hospital for the use of their cases, and in particular to Mr. Philip Hawe and Dr. Winston Evans for their help in preparing this paper, and especially to the latter for his excellent slides and reports.

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# CONGENITAL INTRAPULMONARY ARTERIO-VENOUS ANEURYSM

A REPORT OF A CASE AND A BRIEF REVIEW OF THE LITERATURE

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INTRAPULMONARY arterio-venous aneurysms are rare vascular anomalies consisting of a precapillary communication between the pulmonary artery and vein. The first case was recorded by Wilkens (1917), who described the clinical features and post-mortem findings in a young girl who had died of an intra-thoracic hæmorrhage following the rupture of such a lesion. Smith & Horton (1939) were the first to make an ante-mortem diagnosis, and it was as late as 1942 before a case was successfully treated by surgery (Shenstone, 1942).

The aneurysms may be single or multiple, and result in the return of de-oxygenated blood to the left side of the heart. In the majority of cases recorded the lowered oxygen tension in the arterial blood is sufficient to produce secondary polycythæmia, cyanosis and clubbing of the fingers and toes. These secondary changes have been responsible in many cases for the condition being mis-diagnosed as congenital heart disease or polycythæmia rubra vera. Unlike the traumatic arterio-venous aneurysms occurring in the systemic circulation, cardiac embarrassment is rare, presumably due to the fact that the pressure gradient between the pulmonary artery and vein is very much less than that between artery and vein elsewhere.

## CASE REPORT

A 17-year-old soldier was admitted to hospital for investigation following an abnormal routine chest radiograph. He had no symptoms and found no difficulty in playing games or in his basic army training. There was nothing relevant in his family or past history, but two routine M.M.R. films taken two years previously were said to show a healed primary tuberculous lesion of the left upper lobe.



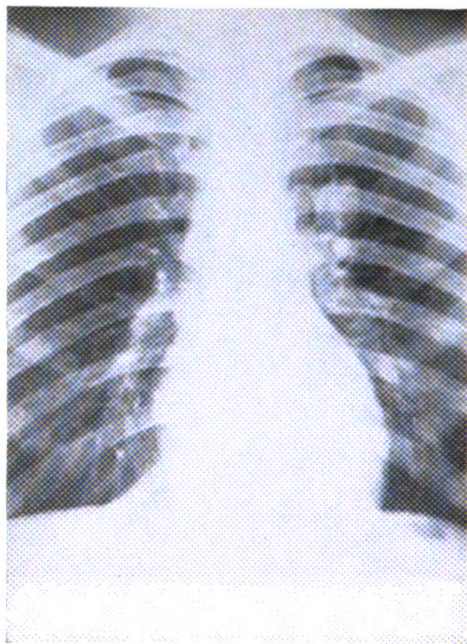


FIG. 1. P.A. chest radiograph showing pulmonary opacity in the left upper lobe

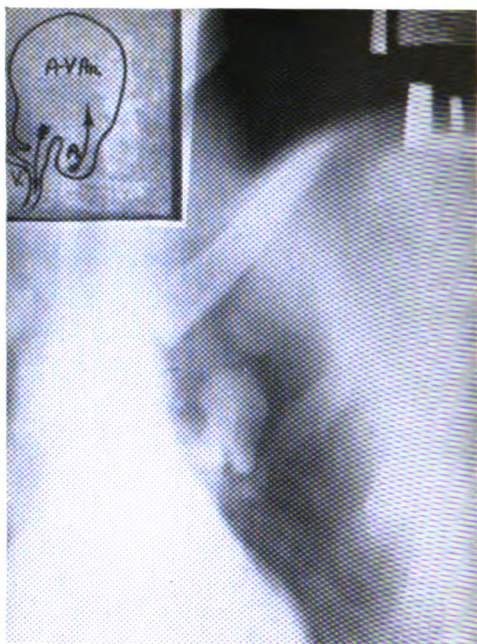


FIG. 2. A.P. tomogram. (A = branch of pulmonary artery. V = branch of pulmonary vein. A-V An = arterio-venous aneurysm.)

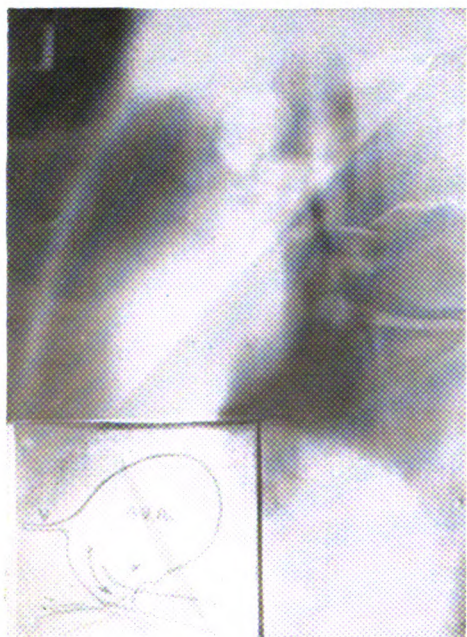


FIG. 3. Left lateral tomogram showing details of the arterio-venous aneurysm

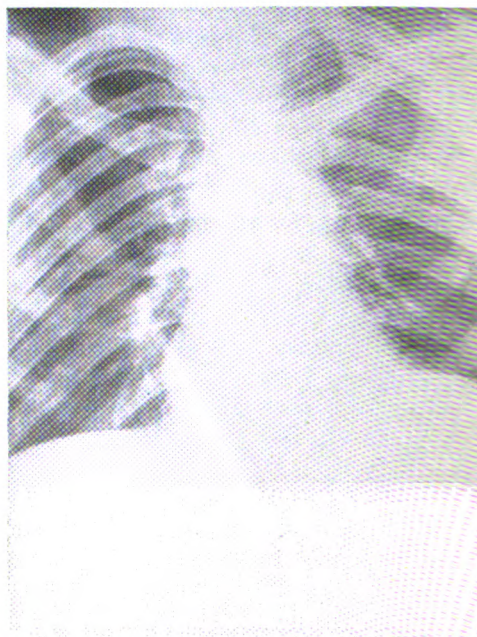


FIG. 4. P.A. radiograph of the chest during convalescence after left upper lobectomy. The left phrenic nerve was crushed at operation

PLATE I. (These figures are described in the text)



On examination he was well developed and his mucous membranes were a good colour. There was no clubbing or any evidence of skin telangiectases. The apex beat lay within the mid-clavicular line, the heart sounds were normal and there were no audible cardiac murmurs. The blood pressure was 105/60 mm. Hg. Immediately below the medial end of the clavicle but above the pulmonary valve area there was a soft blowing murmur commencing in mid-diastole and continuing into and throughout systole; it was unaffected by exertion and respiration. There was no thrill. The rest of the examination showed nothing abnormal.

*Investigations.* E.S.R. (Westergren): 3 mm. in first hour; hæmoglobin, 103 per cent.; R.B.C., 5.2 million per cu.mm.; W.B.C., 10,000 per cu.mm. with a normal differential count. Mantoux reaction negative at 1/100. Postero-anterior chest radiograph showed a rounded opacity just above and near the left hilum (Fig. 1, Plate 1). On screening, the lesion did not pulsate but vibrated with the heart beat, suggesting a close connection with the left hilum. Full plate and left lateral tomograms (Figs. 2 and 3, Plate 1) revealed a large rounded opacity in the anterior segment of the left upper lobe, connected to the left hilum by several large vessels. The lesion was considered to be an arterio-venous aneurysm.

*Operation* (Mr. G. Kent Harrison). The chest was opened by a left postero-lateral thoracotomy incision through the bed of the sixth rib. The lung was free with no adhesions and the surface of the left upper lobe was normal from all aspects. The left upper lobe vein was larger and pulsated more than that of the lower lobe. In the substance of the apical and anterior segments of the upper left lobe a soft pulsating cyst was palpable. No mass of vessels could be felt, but the arterial branches to this area were larger than normal. A left upper lobectomy was performed without difficulty. Apical and basal tubes were inserted and the chest wall closed in layers. Both tubes were removed twenty hours after operation and the patient made an uninterrupted recovery. Fig. 4 shows a radiograph of the chest taken during convalescence.

*Pathology* (Captain F. W. O'Grady, R.A.M.C.). The specimen consisted of the entire left upper lobe. The arterial supply to the lobe was derived from four principal vessels, one of which entered the lung posterior to the main bronchus and gave rise to a small branch supplying the inferior part of the posterior segment of the lobe and a major branch which ran lateral to the main lingular bronchus and supplied the superior segment of the lingula. The venous drainage of this part of the lung was normal. The second vessel arose anterior to the main bronchus, giving rise to the two vessels supplying the inferior segment of the lingula. The arterial supply of the apical segment and upper part of the anterior segment was derived from a vessel entering the lung with the apical bronchus. The remaining major artery entered the lung between the anterior and apical posterior bronchi, and from this a major branch ran posteriorly to supply the posterior segment. Anteriorly it gave rise to a large vessel from which the arterial supply to the inferior part of the anterior segment was derived. This vessel continued into a large thin-walled vein which drained



directly into the auricle. From the horse-shoe shaped vessel joining these two a large thin-walled saccular dilatation arose, lying in the anterior segment covered medially only by pleura. Small vessels ran from this aneurysm into the surrounding lung substance. Veins from the upper part of the anterior and the apical segments drained directly into the aneurysm. The venous drainage of the lower part of the anterior segment, which was supplied from the aneurysm, was normal. Thus the aneurysm supplied the lower part of the anterior segment, the venous drainage of which was normal, and drained the upper part of the anterior segment, the arterial supply of which was normal.

### DISCUSSION

*Ætiology.* The most important ætiological factor appears to be an inherited predisposition to the disease. In 100 cases investigated by Cope (1953) 14 had a family history of cutaneous vascular defects, while two cases of pulmonary arterio-venous aneurysms have been reported in brothers.

The angioblasts of the embryonic lung produce a retiform system of vessels so that there is free communication between pulmonary artery and vein. These early arterio-venous aneurysms are normally obliterated, and it is assumed that should they persist or recanalize they become the basis of pathological aneurysms. The aneurysm produces a localized fall in arterial pressure, resulting in a thinning of the vessel wall with the subsequent dilatation produced by the increased blood flow and high pulse pressure.

*Clinical features.* The outstanding feature in the majority of cases is the cyanosis which can develop to a severity equal to that seen in a true Fallot's tetralogy. It can occur in infancy, but often develops abruptly in the first or second decade and is associated with a secondary polycythæmia, exertional dyspnœa and clubbing of the fingers and toes. These cases often have cerebral symptoms such as fainting attacks, vertigo and convulsions thought to be due to transient attacks of cerebral anoxia. Other symptoms recorded are repeated hæmoptyses and epistaxes, while half of the cases described have had associated cutaneous vascular lesions. On examination the heart is almost always normal in size and the blood pressure is usually within normal limits. When the lesion is peripherally situated a murmur can be heard ; it is usually systolic though occasionally continuous.

*Diagnosis.* Tomography is nearly always a conclusive investigation showing the lesion and its associated dilated vessels. Screening is often disappointing as most of the cases described failed to show pulsation. Arteriograms often show the vascular nature of the opacity but occasionally have been normal in the presence of such a lesion. An intrapulmonary arterio-venous aneurysm should be considered in all cases of central cyanosis in which there is no evidence of cardiac enlargement, especially if an opacity can be seen on the chest radiograph. In the absence of splenomegaly the diagnosis of polycythæmia rubra vera should be reconsidered, though this condition can give rise to difficulty in diagnosis

in that it often produces transient shadows in the lung fields. Cases presenting with abnormal chest radiographs, hæmoptysis and clubbing have been misdiagnosed as pulmonary tuberculosis, bronchiectasis and benign tumours.

**Pathology.** The lesions are thin-walled sacs, often trabeculated, and, as is well shown in the case described, often receive their blood from a part of the lung which has a normal arterial supply and supplies arterial blood to a part of the lung with normal venous drainage. The case we describe, however, is unusual in that the aneurysm was not visible on the surface of the lobe at operation.

**Treatment.** The only effective treatment is surgical removal by pneumonectomy, lobectomy or local excision according to the site, size and number of aneurysms present; several cases have now been recorded of bilateral local excision. Even in the symptomless cases operation should not be delayed, for sudden death can occur from a massive hæmoptysis or an intrapleural hæmorrhage.

### COMMENT

This case emphasizes that a clinical diagnosis should not be made on a radiological finding noted in a M.M.R. or in a solitary P.A. radiograph of the chest.

We stress the importance of deciding whether or not a chest radiograph is abnormal. If it is abnormal, then a routine clinical history and examination, relevant laboratory and other investigations, together with adequate radiological examination, are imperative.

The need is obvious for adequate tomography if intrathoracic abnormalities are to be diagnosed with reasonable accuracy.

### SUMMARY

A case of symptomless congenital intrapulmonary arterio-venous aneurysm is presented in which the only finding was a pulmonary opacity in a fortuitous radiograph of the chest and which was erroneously diagnosed as a healed primary tuberculous lesion.

The genesis, clinical findings, pathology and treatment of such lesions are discussed.

### ACKNOWLEDGMENTS

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# AN INVESTIGATION INTO THE CLINICAL AND LABORATORY FEATURES OF AN OUTBREAK OF 31 CASES OF AN-ICTERIC LEPTOSPIROSIS

BY

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THE first case of leptospirosis in Malaya was encountered by Fletcher in 1925, when he was investigating the isolation of *Rickettsiæ* from cases of fever of unknown origin. Galloway (1926) described four icteric cases with a very severe clinical picture. Fletcher (1928) reported 32 cases investigated at Kuala Lumpur. Since then the disease has been recognized increasingly throughout the country, and cases have been described by Lewthwaite (1929) and Danaraj (1950). A limited serum survey of members of the civil population has shown evidence of infection in a quarter of those tested (Wisseman *et. al.*, 1955). Leptospirosis has been one of the hazards facing security forces engaged in jungle warfare (Broom, 1953), and has also achieved military importance elsewhere in the Far East (de la Judie & Brygoo, 1953).

The purpose of this paper is to describe the clinical and laboratory investigations performed on 31 cases of leptospirosis admitted to a British Military Hospital in Malaya at the end of 1953. All the patients were from the same British Army unit and were engaged on routine security operations mainly in primary jungle. Of the 31 cases, 29 were proved by either cultural or serological methods to be leptospirosis. The remaining 2 cases had such typical clinical and laboratory features as to make the diagnosis very probable.

## METHODS

### SELECTION OF CASES

The men were all private soldiers or junior N.C.Os. who were evacuated to hospital as soon as possible after the onset of their symptoms and were thus (with two exceptions) seen at the hospital on the first or second day of the illness. All were young men and not one showed icterus.

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## LABORATORY STUDIES

In addition to routine examination of thick and thin blood films for malarial parasites, blood culture and serological examination of the blood—Weil-Felix and Widal agglutination tests (all of which were negative)—the following investigations were carried out :

*Examination of urine.* Daily examination of the sediment after centrifugation of at least 20 ml. of urine was carried out on every patient until several successive normal results had been obtained. Chemical examination for protein, bile and urobilinogen was done at the same time.

*Hæmatological investigations.* The following routine tests were repeated at frequent intervals during the course of the illness :

Total and differential white cell counts. 10,000 per cu.mm. was taken as the upper normal limit.

Hæmoglobin estimation. The oxy-hæmoglobin method was used with the Grey-Wedge photometer. For the purpose of this study 13.0 g. per cent. was taken as the lower limit of normality.

Reticulocyte counts, bleeding time, clotting time, and platelet counts.

In addition, sternal marrow biopsy was performed in one case.

*Biochemical investigations.* Blood urea. The urea nesslerization method was used as adapted for the Lovibond comparator. 40 mg. per 100 ml. blood was taken as a normal upper value.

Plasma proteins. The micro-Kjeldahl method was used and the test performed during the acute and convalescent phase of the illness in selected cases. Electrophoretic fractionation of the serum globulin was also performed. These tests were carried out by Dr. R. Young, Biochemical Department, The Institute for Medical Research, Kuala Lumpur.

Serum bilirubin. Estimations were made once during the course of the illness.

## DEFINITIVE DIAGNOSIS

*Leptospiral isolation.* One drop of whole blood obtained by venepuncture soon after admission was inoculated into each of three tubes containing 10 ml. of Fletcher's medium and incubated at room temperature (26° C.). This work was done by members of the United States Army Medical Research Unit, at the Institute for Medical Research, Kuala Lumpur. The strains obtained were later identified by absorption tests.

*Serological identification.* Agglutination-lysis tests were performed on sera obtained soon after admission, and on late phase specimens obtained during the second week of the illness. Serological identification was performed by Dr. J. C. Broom, The Wellcome Laboratories of Tropical Medicine, London, N.W.1.

## CLINICAL PICTURE

In this outbreak, the severity of the illness and its duration varied within wide

limits. Some patients rapidly became ill with severe headache, limb and body pains, and a high temperature. In other cases, however, the illness was mild and of short duration.

### SYMPTOMS (See Table 1)

The onset of the symptoms occurred gradually in 20 cases, over a period of twelve to eighteen hours. In 4 cases the symptoms developed in from two to six hours, and in the remaining 7 the onset was sudden with no prodromata.

### PHYSICAL SIGNS (See Table 2)

*Pyrexia.* The duration of fever varied from one to eleven days, but in over half the cases it was between four and eight days. In 5 cases a secondary rise of

Table 1. *Showing the incidence of symptoms*

(a) At the onset of illness.

(b) Throughout the course of the illness.

Symptom	(a) At onset	(b) Overall
1 Headache ... ..	29	30 (97%)
2 Weakness ... ..	19	22 (71%)
3 Abdominal pain ... ..	10	21 (68%)
4 Backache ... ..	15	19 (61%)
5 Nausea ... ..	16	19 (61%)
6 Vomiting ... ..	6	17 (55%)
7 Limb pain ... ..	12	14 (45%)
8 Photophobia ... ..	7	10 (32%)
9 Constipation ... ..	5	10 (32%)
10 Dizziness ... ..	4	8 (26%)
11 Sore throat ... ..	4	8 (26%)
12 Dry cough ... ..	4	7 (23%)
13 Diarrhoea ... ..	1	3 (10%)
14 Loss of consciousness ... ..	0	3 (10%)
15 Confusion ... ..	0	1 (3%)

Table 2. *Showing the incidence of physical signs*

(a) On admission to hospital.

(b) Throughout the course of the illness.

Sign	(a) On admission	(b) Overall
1 Fever ... ..	30	31 (100%)
2 Conjunctival injection ... ..	16	19 (61%)
3 Rash ... ..	1	18 (58%)
4 Congested fauces ... ..	16	16 (52%)
5 Lymphadenopathy ... ..	8	12 (39%)
6 Tender calves ... ..	7	9 (29%)
7 Hæmorrhagic signs ... ..	0	9 (29%)
8 Neck stiffness ... ..	8	8 (26%)
9 Oliguria ... ..	3	7 (23%)
10 Rigor ... ..	4	6 (19%)
11 Tender abdomen ... ..	6	6 (19%)
12 Kernig's sign ... ..	1	3 (10%)
13 Splenic enlargement ... ..	0	2 (6%)
14 Nystagmus ... ..	1	1 (3%)
15 Herpes ... ..	1	1 (3%)
16 Convulsions ... ..	0	1 (3%)

temperature occurred between the fourth and ninth day. On admission 25 cases had a temperature of 102° F. or over, and temperatures of 106° F. were reached during the course of the illness in 3 cases. One patient (case 29) remained apyrexial during his stay in hospital.

**The Rash.** A rash appeared in 18 cases (58 per cent.). It consisted of rose-red macules 2-4 mm. in diameter, which faded on pressure. The rash appeared between the fourth and eleventh days of the illness, and was distributed mainly over the upper part of the chest and abdomen, and distally on the limbs, especially on the extensor surfaces.

**Muscular tenderness.** Tenderness on palpating the calf muscles was noted in only 9 cases (29 per cent.). Signs of meningism (neck stiffness and/or a positive Kernig's sign) were likewise only found in 9 cases.

**Lymphadenopathy.** Moderately enlarged, painless, discrete lymph nodes were palpated on admission or became palpable in 12 cases (39 per cent.). In

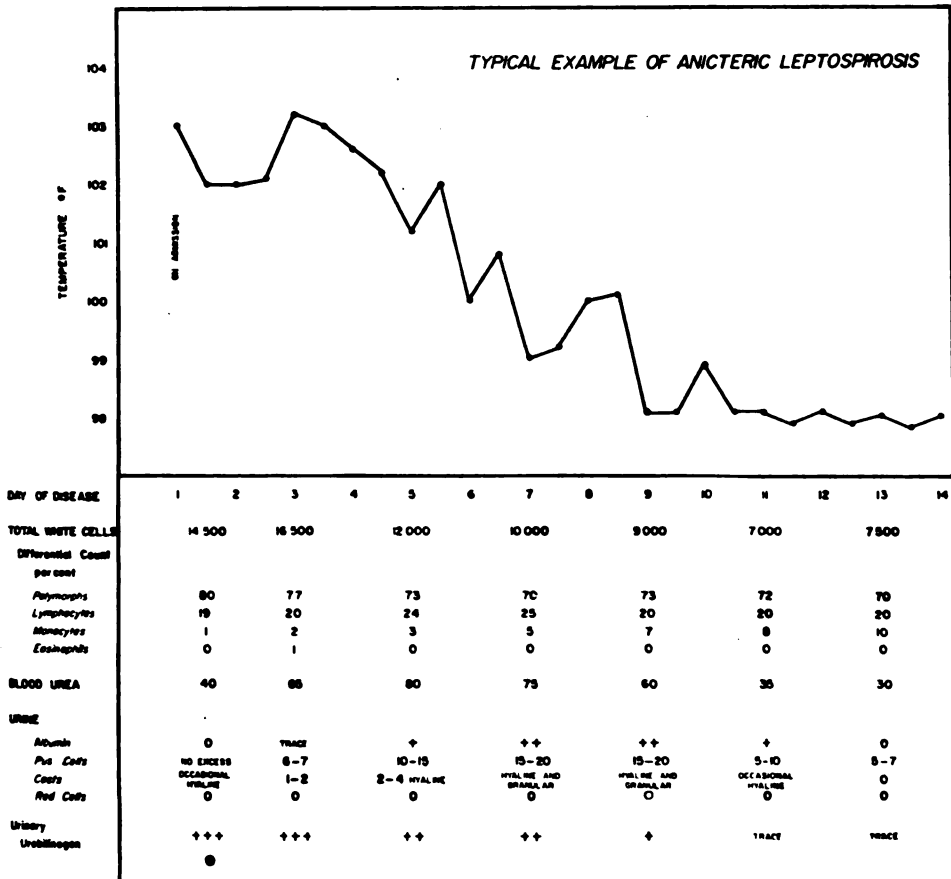


FIG. 1

8 cases (26 per cent.) they were noted in the posterior triangles of the neck. Other sites were the axillæ, groins, sub-mandibular and the supratrochlear regions. In 2 cases the glands were found in all these areas.

*Splenomegaly.* In 2 cases the spleen was palpated one finger breadth below the costal margin, firm but not tender. By the fifth day it was no longer palpable.

*Hæmorrhagic manifestations.* These occurred in some form in 9 cases (29 per cent.) between the fourth and eighth days. The bleeding was never severe. The sites were as follows :

Blood-streaked sputum	...	...	...	...	3 cases
Small hæmatemesis	...	...	...	...	2 cases
Epistaxis	...	...	...	...	1 case
Strongly positive occult blood in stools	...	...	...	...	1 case
Large sub-conjunctival hæmorrhage	...	...	...	...	1 case
Hæmaturia	...	...	...	...	1 case.

*Oliguria.* Some diminution in output as compared with the fluid intake was observed in 7 cases, occurring between the second and ninth days of the illness. In 2 cases it was severe, but in the other patients oliguria was not a marked feature.

*Fits.* Generalized clonic convulsions occurred in one case, on the fourth day and again fourteen days later during convalescence.

#### REPRESENTATIVE CASE REPORT

Case 9, aged 20 years. The patient was on a jungle patrol when he complained of a severe frontal headache which began abruptly and was stabbing in character. He felt weak, ill and feverish. Later in the day he complained of backache and of mid-abdominal pain, and vomited. He was evacuated to hospital by helicopter the next morning. On admission, in addition to the symptoms already mentioned, he complained of slight photophobia and of aches in the legs. He was pale and ill-looking and his mouth and tongue were dry. The temperature was 103° F. There was slight but definite conjunctival injection, and some congestion of the fauces. Neck stiffness was present but Kernig's sign was negative. There was no calf tenderness. The blood pressure was 100/60 mm. Hg. He remained moderately ill with frontal headache, conjunctival injection and dull generalized abdominal pain for about three days. His appetite was poor but there was no further vomiting. A slight diminution in the urinary output, compared with the fluid intake, was noted. His condition then began to improve, and the headache and pains left him. His temperature subsided on the sixth day of the illness. On the fourteenth day he was fit enough to go on convalescent leave.

The temperature chart of this case, together with some of the laboratory findings, is shown in Figure 1.

## LABORATORY STUDIES

The results of positive laboratory findings in relation to the course of illness are shown in Table 3.

*Examination of urine.* Of the 31 cases, 26 showed an abnormal urinary deposit on microscopy at some stage of the illness.

They are divided into three groups according to severity :

Large numbers of hyaline casts only ... 3 cases (10 per cent.)

Slight excess of pus cells (5-6 per H.P. field)

with or without casts ... 10 cases (32 per cent.)

Greater excess of pus cells (10-50 per H.P.

field) ... 12 cases (39 per cent.).

In one case the predominant urinary abnormality was hæmaturia. Of the 26 cases, 18 had shown some urinary abnormality by the fifth day, 22 by the seventh, and all by the tenth day. Mild abnormalities lasting only a few days were found in 11 cases. Intermittent pyuria was found in 5 cases.

*Chemical Tests.* Proteinuria was present in 22 cases (71 per cent.), varying from a trace to a definite cloud on boiling.

Urobilinogen. A marked excess was found in 5 cases.

Biliuria. Bile salts and bile pigments were absent from the urine in every case.

*Hæmatological investigations.* Total and differential white cell count. Values above 10,000 per cu.mm. were found in 17 cases, and in all cases the increase was

Table 3

Tests performed	Periods of illness during which tests performed (days) 1-3 4-6 7-9 10-12 13-15 16-18	Number of cases		Percentage of cases with abnormal results.
		A. Test done	B. Test abnormal	
Urine Examination		A.	B.	
Total tests ...	22 34 41 19 17 2	30	26	87
Number abnormal ...	11 27 22 6 4 2			
Total white cell count				
Total tests ...	17 19 12 13 13 4	31	17	55
Number abnormal ...	4 9 2 6 5 0			
Hæmoglobin				
Total tests ...	1 10 12 5 10 6	25	15	60
Number abnormal ...	0 4 6 2 6 2			
Blood urea				
Total tests ...	14 17 22 7 11 5	30	17	57
Number abnormal ...	7 9 11 0 1 0			
Albumin-Globulin ratio (inversion)				
Total tests ...	6 2 3 2 1	10	10	100
Number abnormal ...	6 2 3 1 0			



due to a neutrophil polymorph leucocytosis, the absolute lymphocyte count remaining within normal limits. The leucocytosis was found as early as the first day, and tended to persist over the first week, although in 4 cases the white count had dropped below 10,000 per cu.mm. by the seventh day. In 6 cases there was an absolute monocytosis (4,000-9,000 per cu.mm.) found at the beginning of the second week of the illness, and subsiding over the next few days.

**Hæmoglobin levels.** A reduced blood hæmoglobin level was found in 15 of 25 cases examined. The lowest figures were obtained between the sixth and tenth days, although in one case a hæmoglobin of 9.7 g. per cent. was found on the fourth day and in another patient a level of 7.8 g. per cent. on the sixth day. In 4 cases the hæmoglobin fell below 10 g. per cent. Although the levels tended to return to normal after the second week, 3 cases still had readings between 9 and 13 g. per cent. on the eighteenth to nineteenth days of their illness. The low hæmoglobin levels were accompanied by a reduced packed cell volume and lowered mean corpuscular hæmoglobin concentration.

Reticulocyte counts, bleeding time, clotting time and platelet counts were performed on nine cases who showed hæmorrhagic manifestations and on those who showed anæmia. The results were all within normal limits.

Table 4

Case number	Serological identification (Agglutination-lysis)	Leptospiral isolation	Sero-group identification
1	+	Not done	Unknown
2	+	Not done	
3	+	+	
4	+	Not done	
5	+	—	
6	+	+	<i>schuffneri</i>
7	+	+	<i>canicola</i>
8	+	+	<i>hebdomadis</i>
9	+	+	<i>icterohæmorrhagiae</i>
10	+	+	<i>pyrogenes</i>
11	+	+	<i>pyrogenes</i>
12	+	+	<i>pyrogenes</i>
13	+	+	<i>pyrogenes</i>
14	+	+	<i>hebdomadis</i>
15	+	+	<i>pyrogenes</i>
16	+	+	<i>hebdomadis</i>
17	+	—	Unknown
18	+	+	
19	+	+	
20	+	+	Unknown
21	+	—	<i>hebdomadis</i>
22	+	+	
23	+	+	
24	+	+	<i>paidjan</i>
25	+	+	<i>pyrogenes</i>
26	+	Not done	Unknown
27	+	+	
28	+	+	
28	Not done	Not done	<i>schuffneri</i>
29	+	Not done	
30	+	Not done	
31	Not done	Not done	

Sternal marrow biopsy was performed on one case where the hæmoglobin had initially fallen to 7.8 g. per cent. The cellular elements were normal in appearance and in distribution.

**Biochemical investigations.** Blood Urea. A raised blood urea was found in 17 cases. Nine showed a level between 45 and 60 mg. per 100 ml. blood and the remaining 8 had levels ranging from 60 to 220 mg. These higher levels were found in the more severe cases with impaired renal function.

**Plasma Proteins.** Estimation of the serum protein fractions was carried out in 10 cases. The total serum proteins were in all cases normal. There was lowering of the serum albumin in all the sera with a concomitant rise of the serum globulin fraction. These changes were most marked in the early stages of the illness. In all the sera tested there was elevation of the  $\alpha_1$ ,  $\alpha_2$  and  $\gamma$  globulin fractions.

**Serum Bilirubin.** In no case was the level above normal.

#### DEFINITIVE DIAGNOSIS

The results of cultural isolation and serological identification are shown in Table 4.

**Leptospiral isolation.** *Leptospiræ* were isolated from 20 cases. Those isolated belonged to the following sero-groups: *canicola*, *hebdomadis*, *ictero-hæmorrhagiæ*, *pyrogenes*, *schüffneri*, *paidjan*.

**Serological identification.** Of the sera tested by agglutination-lysis, 29 showed a significant rise of antibody titre.

#### EPIDEMIOLOGICAL CONSIDERATIONS

At first it appeared that this was a single outbreak, the explosive nature of which suggested a similar if not common source of infection at the permanent camp site. The weather had been unusually dry immediately before the outbreak, and it was known that the men had been bathing in streams near their camps; furthermore, rats had been seen at the camp sites, and some had been caught in the men's tents.

When the distribution of cases is analysed (Fig. 2), it is evident that what was thought to be a single outbreak was in fact made up of a number of outbreaks affecting the individual companies.

There is evidence that infection did not occur at the company camp sites. The outbreak affected men from each company, the disposition of company sites was such that each was approximately ten miles from the other, and personal communication between each was limited. Furthermore, "D" and Support companies occupied the same camp site, and camp activities were communal, yet the outbreaks in the respective companies occurred at different times. Thus it appeared unlikely that there was a common source of infection in camp.

It was suggested that men had become infected through bathing in rivers and streams adjacent to the camp site, but only 7 men gave a history of swimming

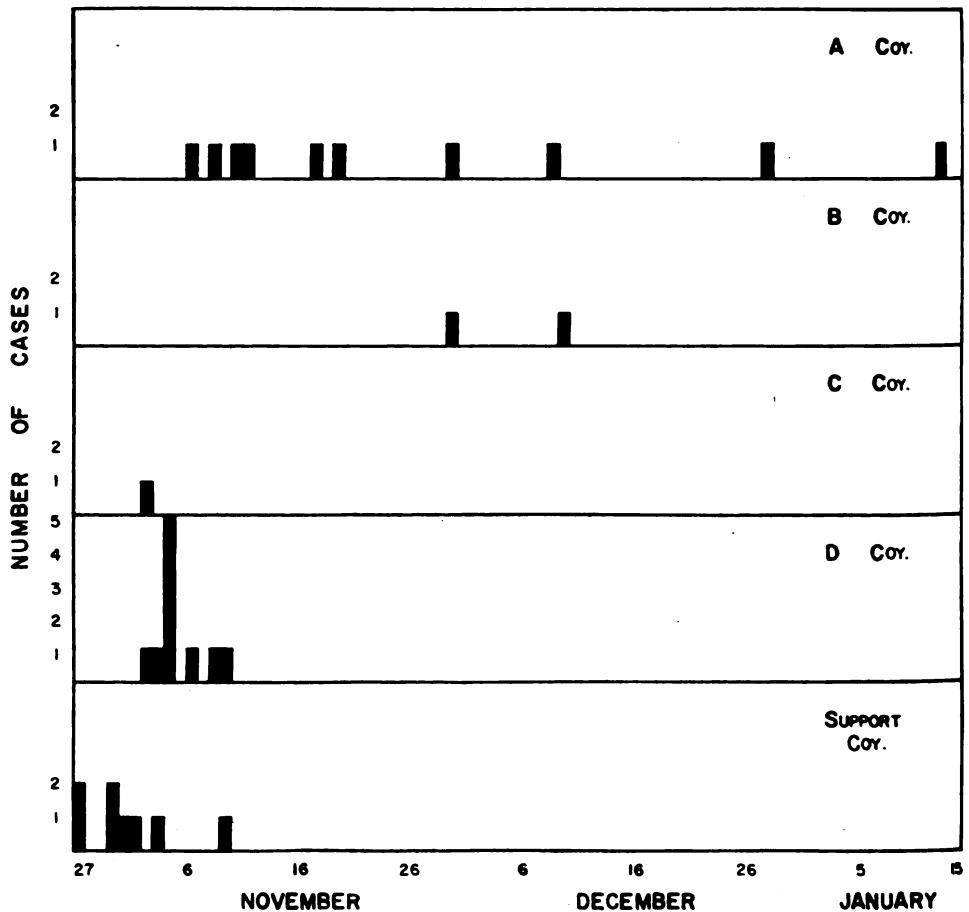


FIG. 2. The distribution of cases

in these places during the three weeks before the onset of illness. Moreover, 14 men stated that they had not swum during that period. On the other hand, all the men affected were engaged on routine patrols, mainly in primary jungle where rivers and swamps made wading and sometimes swimming necessary.

Of the 31 cases, 18 occurred in two companies (*vide supra*) that shared the same camp (Sungei Penjuring). A further 10 cases occurred soon after the first outbreak, which has been described, in another company at Sungei Pertang. The remaining three cases were from two other companies based elsewhere in the Bentong district.

It must be particularly noted that nearly all the cases in each company occurred in one platoon. This applied to 8 of 10 cases in "D" company, 5 of 10 cases in "A" company, 4 of 8 cases in Support company and both cases in "B" company. The significance of such a distribution is explained when it is

realized that each jungle patrol comprises men from a single platoon, and that each patrols different localized areas of jungle.

Infection must thus have been encountered separately by each patrol.

### DIAGNOSIS

The value of laboratory investigations in the diagnosis of this disease cannot be over-emphasized. The most important single test was found to be the microscopical examination of the urinary sediment. At an early stage of the disease the changes found were often slight. However, the earliest urinary abnormality was the presence of hyaline or finely granular casts, with or without a slight increase of pus cells or the presence of proteinuria. This finding in a clinically suspect case has considerable diagnostic value. It must be remembered that all the patients affected in this outbreak, were healthy males under the age of thirty years. In higher age groups the same diagnostic significance could not perhaps be placed on it.

Abnormal cytology of the urine at first consisted of no more than a slight excess of pus cells, but it was a very constant finding and in some cases occurred in the absence of casts. The urinary changes were sometimes transient and would probably have been missed without repeated examination, but in most cases the condition progressed to a definite pyuria accompanied by coarsely granular and pus casts. There was a definite correlation between the degree of renal involvement as judged by microscopy of the urinary sediment and the blood urea, although (especially in the milder cases) urinary abnormalities were noticed before any rise occurred in the urea level.

### DISCUSSION

The condition was in most cases mild as compared with classical Weil's disease. There was no mortality.

The low hæmoglobin level found in several of the cases has not been satisfactorily explained. Of the 9 cases with hæmorrhagic manifestations, anæmia was found in only 4. There was no apparent correlation between the small amount of blood lost and the degree of anæmia. Nor was there any correlation between the anæmia and the amount of urobilinogen excreted. The reticulocyte count was not raised. The relation between the severity of urinary upset and the anæmia was similarly not obvious—in 5 cases where the anæmia occurred the urine showed minimal changes, and in one case remained normal. It is thought that the anæmia was due to dys hæmopoiesis in most part, a direct result of the leptospiral infection.

The concept of a jungle as opposed to a camp source of infection is one which has an important bearing on future investigations. The reason why infection should occur in the jungle is not yet clear. It might appear at first sight that infection would be more likely at the permanent camp site, for it is well known that a change of fauna and a marked increase in rodent population occurs in

proximity to human habitation (Smith, 1955). However, the camp site is comparatively dry and the standard of hygiene of the men incomparably higher than when on jungle operations. It is evident that other epidemiological factors must be considered, for it is emphasized that jungle patrols in this district were confined to areas of primary forest, and contact with human habitation was infrequent. It is more likely that foci of infection occur in the jungle, their extent and infectivity being governed by the ecology of the jungle hosts.

### SUMMARY

1. An outbreak of leptospirosis affecting 31 men in a British Army unit serving in Malaya, is described.
2. The clinical picture varied in severity, but in most cases was mild and self-limiting.
3. Twenty-nine of the 31 cases were proven by cultural or serological means to be leptospirosis. 6 different sero-groups have been identified.
4. The most important single diagnostic test was the microscopical examination of the urinary sediment.
5. Evidence is given in favour of a jungle source of infection.

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## ACUTE HYPERFLEXION WITH VISCERAL INJURY

BY

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ACUTE hyperflexion is recognized as a cause of visceral injury. Three cases are described in which flexion to a greater or lesser degree was a factor common to all. The crush element is an inevitable concomitant to such relatively gross injuries, but from the absence of local evidence of cutaneous contusion in each case it was not considered to be a very significant feature. Cases 1 and 2 were examples of traumatic rupture of spleen. The latter was of interest in the somewhat dramatic manner of presentation. Case 3 had a duodeno-jejunal rupture and was thought to be sufficiently instructive to merit description at some length.

### *Case 1*

E. D., aged 19. Lost control of his motor-cycle at apparently low speed and was flung against a grass bank, shoulder first. From an eye-witness account he "doubled up" at the moment of impact. On admission he was mildly shocked but felt sufficiently well to inquire about the prospect of food. There was complaint of slight abdominal pain and on examination minimal tenderness in the left hypochondrium. The upper abdominal pain improved over the next two days, but on the third day there was complaint of left shoulder pain with definite guarding in the left hypochondrium. Laparotomy was considered advisable. The spleen was exposed through a left paramedian incision. There were traces of recent hæmorrhage and a tear in the region of the upper pole was bleeding freely. Mobilization resulted in severe hæmorrhage which was controlled by hilar pressure and splenectomy was performed. Examination of the specimen revealed a tear of the capsule, but it was not possible to demonstrate a hæmatoma. Recovery was uneventful and he was discharged to a convalescent centre eighteen days after operation.

### *Case 2*

J. R., aged 22. There was a history of injury resulting from emergency application of brakes on a heavy lorry, with loss of control and abrupt de-acceleration from a head-on collision with a tree. The driver was violently flexed over the cabin door but was able to assist himself, and was subsequently admitted to a military hospital. The physical signs then were such as to indicate admission to an orthopædic ward. The only complaint in the following three days was dorso-lumbar backache. This improved rapidly. On the sixth day, while sitting up in bed reading, the patient suddenly complained of blindness and nausea. When seen fifteen minutes after this incident he was extremely shocked, but vision

had returned. The abdomen showed generalized tenderness and guarding. There was no complaint of shoulder pain. Following resuscitation, left paramedian laparotomy disclosed a gross upper pole tear extending from periphery to hilum. Hæmorrhage was profuse and sufficient to cause considerable difficulty in mobilization and removal of the spleen. Subsequent examination of the spleen showed that the probable pathological sequence was an initial sub-capsular hæmorrhage, and judging from the extent and localization of the hæmatoma it was assumed that the capsule had remained intact at the time of injury. The tear and secondary hæmorrhage corresponded in a relatively accurate manner to the plane of demarcation between hæmatoma and normal splenic tissue. Convalescence was uneventful apart from a left basal collapse. The patient was discharged on convalescent leave three weeks after operation.

### *Case 3*

J. K., aged 21. Injuries resulted from a traffic accident at speed with contusion and hyperflexion over the steering column. On admission there was a moderate degree of shock. The abdomen showed generalized tenderness with epigastric guarding. Bowel sounds were not present. There was no evidence of cutaneous contusion. His general condition improved rapidly, the initial blood pressure being 110/80. Once the primary shock was recovered from, complaint was of thirst and hunger only. It was, however, decided to withhold fluids. Trans-nasal gastric suction and intravenous fluid therapy was commenced and over twelve hours 150 ml. of fluid were aspirated. Bowel sounds were now present. Straight radiography of abdomen failed to disclose evidence of free gas or obstruction. Abdominal signs were minimal, consisting of localized epigastric tenderness and guarding on deep pressure. Twenty-four hours after admission the patient was seen by the Consulting Surgeon, who advised continuation of the conservative régime. On the second morning, thirty-nine hours after admission, considerable upper abdominal pain and nausea were complained of and coincident with this there was an abrupt deterioration in condition associated with epigastric and left-sided rigidity. Following rapid resuscitation, left paramedian laparotomy was performed. The spleen showed no abnormality. A large transverse tear involving two thirds of the circumference of the fourth part of the duodenum was present. This tear involved all layers and the lumen, at the time of the operation, was freely exposed. A striking feature was the lack of free fluid in the peritoneal cavity. The tear was closed by a single layer of interrupted catgut sutures. A Miller-Abbot tube was threaded through the pylorus to the third part of the duodenum and continuous suction commenced. Marked bruising of the pancreas was noted. The abdomen was closed without drainage. Immediate convalescence was relatively uneventful; the significant complication being a bilateral basal atelectasis which responded to physio-therapeutic measures. The incision healed satisfactorily, but a low-grade intermittent pyrexia was present throughout convalescence. On the twentieth day the lower third of the incision was tender and subsequently a small sinus appeared which discharged a clear alkaline fluid, containing trypsin and amylase. This fistula persisted in an

intermittent fashion for three weeks. Treatment consisted of continuous suction and application of barrier creams. His weight remained around 96 pounds, resisting all efforts of improvement. On the fifth week a mass was palpable in the right iliac fossa. Through an incision in the region of the anterior iliac spine it was approached retro-peritoneally and 25 ounces of pus were evacuated. Culture of this proved it to be sterile. There was a weight gain of 16 pounds over the following three weeks and he was ultimately evacuated to the United Kingdom.

### DISCUSSION

It has not been possible to find much relevant material on injuries with this ætiology. Teare (1951) in his autopsy report on twenty-eight victims of an air accident showed that sixteen out of twenty-eight deaths resulted from abrupt de-acceleration and hyperflexion over the safety belt. The thoraco-abdominal visceral lesions were of a gross nature. Delayed rupture of the spleen is a group constituting 15 per cent. of all traumatic splenic injuries, and the operative mortality is thought to be in the region of 10 per cent. In the absence of surgery the mortality ranges from 77 to 100 per cent. In case 2 secondary hæmorrhage was of abrupt onset and massive extent. The abdominal signs were of generalized peritoneal irritation and a diagnosis was made on laparotomy.

Rupture of the hollow viscus is said to occur most frequently at the sites of fixation and thus the incidence is relatively high at the commencement of the jejunum and termination of the ileum (Counseller & McCormack, 1935). Many of the contributors to this subject emphasize how frequently trivial injuries can be associated with gross lesions. It is believed that leakage in the first six hours is generally slight (Fraser & Drummond, 1917). Prior to the introduction of antibiotics and chemotherapy the mortality was in the vicinity of 10 per cent. with a rather arbitrary 15 per cent. increase with each four hours' delay period before operative treatment (Lockwood, 1934; Maingot, 1955). Recent series present the subject in a more optimistic light and in particular operative delay is not quite so destructive a feature. Following subtotal intestinal rupture the sealing mechanism is said to be the contraction of the circular muscle fibres combined with mucosal pouting, and initially this is thought to be moderately efficient. A case has been reported where this natural seal was effective for thirty-six hours (Vignoli & Gordon-Taylor, 1953).

In case 3 it was thought that the interval between the original injury and the appearance of symptoms and definitive physical signs was a rather extended manifestation of this mechanism.

### SUMMARY

Three cases are presented of visceral injury in large part resulting from a hyperflexion strain. In each case the crush element was present, but the absence of local contusion was taken as an indication that this factor was not a predominant ætiological feature. The series may suggest a certain lack of sensitivity to the finer points of diagnosis of the acute abdomen and perhaps an excessively



conservative approach to the problem, but it does illustrate that in young healthy subjects the conventional physical signs of abdominal catastrophe are often minimal.

My thanks are due to the Consulting Surgeon, NORTHAG, for his consistent support and assistance.

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#### Book Reviews

MODERN OPERATIVE SURGERY. Edited by the late G. Grey Turner and Lambert Charles Rogers. Vol. I. New fourth Edition. London: Cassell & Co. Ltd. 1955. Pp. 1,229 + xx. Illustrated. 70s.

This book is well known to all surgeons in the Corps. The surgery of the abdomen is again excellently presented and there is a masterly chapter on amputation by Sir Gordon Gordon-Taylor. The chapters on orthopædic surgery are not wide enough in scope or details and the chapter on operations on blood vessels does not include the modern trends in arterial grafting or agree with our ideas on varicose veins. But we look forward to Volume II of this new Edition. Like Volume I, it is sure to reflect the surgical wisdom of Grey Turner. This is a standard book which must be in the surgeon's library.

C. M. M.

DISEASES OF THE NERVOUS SYSTEM. By Sir Russell Brain, Bt., D.M., P.R.C.P. Fifth Edition. London: Oxford University Press. 1955. Pp. 996 + xviii. Illustrated. 55s.

This edition surveys all the increase of knowledge gained during the past four years, but the basic essentials of neurology—the anatomy and physiology in relation to signs and symptoms of diseases of the nervous system—are still one of the principal features. Up-to-date knowledge on subarachnoid hæmorrhage, injuries of the brain, meningitis and the nervous complications of miscellaneous infections such as infective hepatitis, glandular fever and typhus fever, are of special interest to medical officers in the Services.

The chapter on virus infections of the nervous system is perhaps the most important one for medical officers in the tropics. This section includes poliomyelitis which takes on a severe form in warmer climates, rabies and the nervous complications of anti-rabic treatment (a question occurred on this in the last

D.T.M. & H. paper) and Japanese B. encephalitis. The latter disease is now known to be more widespread over the Far East than was originally thought. There is extensive literature in American journals and text-books relating to it ; one wishes more of this had been included in this edition.

Nutritional neuropathies of obscure origin, especially in the tropics, interests those medical officers looking after African and Asiatic patients. Only one page is devoted to this subject, however.

Neuropathy and myopathy associated with carcinoma is an interesting and necessary addition included in this volume. Of common and particular interest to Service doctors is the section on migraine, epilepsy, syncope and vasovagal attacks. This edition is a mine of up-to-date information.

W. D. H.

**STUDIES ON THE CEREBRAL CORTEX.** By S. Ramon y Cajal. Translated from the Spanish by Lizabeth M. Kraft. London: Lloyd-Luke (Medical Books) Ltd. 1955. Pp. 179 + i. 27s. 6d.

This book is a translation of a series of Cajal's neuro-anatomical papers, which have hitherto only been available in Spanish or in part in German translation. The book is extremely well produced and illustrated and deserves a place on the shelves of any medical reference library, though it is hardly likely to command a wide circulation. The translation is excellent and most readable.

J. L. W.

**TEXT-BOOK OF OCCUPATIONAL THERAPY.** By E. N. M. O'Sullivan, B.A., M.B., D.P.M. London : H. K. Lewis & Co. Ltd. 1955. Pp. 320 + x. 21s.

This book is a very complete and detailed one of its kind. It contains a good deal more than it is necessary that a medical supervisor or administrator should know. It is in fact, what it purports to be, a "text-book" of occupational therapy. The author gives a balanced and reasoned view of the subject-matter, chiefly with reference to psychological medicine, though much can be found of value and interest to occupational therapists concerned with general, special, orthopaedic and surgical hospitals. He is rightly insistent that occupational therapy is primarily a form of treatment modified for each individual patient.

R. G. D.

**THE ESSENTIALS OF FORENSIC MEDICINE.** By C. J. Polson, M.D., F.R.C.P. London : The English Universities Press, Ltd. 1955. Pp. 561 + x. 30s.

Despite its title, when the companion volume on toxicology is added, this book will be little shorter than existing text-books on forensic medicine.

The author tries to make a virtue of the absence of pictorial aids which, he implies, distract the reader's attention from the text. Few will agree with this premise. However, their absence keeps the cost of publication down to a reasonable figure. In their place he uses case reports and these increase the readability of the text and create an additional market, for lawyers and journalists should find this a useful book.

An innovation in this type of text-book is the comparatively large space (about a hundred pages) devoted to subjects wherein the medical practitioner may find himself concerned with the law. Too often in the past it has been left to the Medical Defence Societies to inform practitioners on these matters.

The reader will conclude that forensic medicine is very much a specialized field for the expert, and if he previously wondered why medical evidence is so often conflicting he will appreciate the reasons better.

Finally, the printing and the index deserve a word of commendation, the latter particularly making this a suitable work of reference.

H. R. M.

MEDICAL HISTORY OF THE SECOND WORLD WAR. THE ROYAL AIR FORCE MEDICAL SERVICES. Commands. Edited by S. C. Rexford-Welch. Vol. II. H.M.S.O. 1955. Pp. 703, plates 54. 75s.

The second volume of the Royal Air Force Medical History deals with the nine Home Commands and three closely allied formations—the Second Tactical Air Force, the R.A.F. Regiment and No. 60 Group. The Commands in the title are not geographical as the Army reader might expect.

Each narrative begins with an introduction giving an outline history of the Command and an account of the operational background. This is invaluable in co-ordinating the medical picture.

As the scene is mainly set in the United Kingdom where the environment was already well under control Preventive Medicine does not play the decisive part which is normally to be found in any medical war history. Nevertheless it still accounts for a substantial portion of the technical material. There is a full account of the steps taken to deal with operational casualties and the volume throws some interesting light on problems peculiar to Aviation Medicine; indeed much of this material is hitherto unpublished.

In the chapter on Maintenance Command there is an admirable synopsis on the problems of Industrial Hygiene. The variety of these problems is greater than one might have expected.

There are some interesting details on "Flying Stress," a term synonymous with the Army's "Battle Exhaustion." The extent of the problem is not clearly indicated, but a heavy incidence in Bomber Command, where the individual faced a hazardous and uncertain future, is only to be expected. Although much was done in the way of leave, recreational amenities and the best possible living standards for aircrew, heavy casualties in the Command must inevitably have lowered morale. Nor did the airman have the traditions and corporate strength of the Regiment, by which the soldier was able to sustain himself to such a large extent when he was exposed to combat stress.

Those of us who have had experience in assessing volunteers for parachute duties will be interested in the pages on Parachute Training. In particular the graphs correlating injury rates with age, height and weight are of great interest and fully justify the existing physical restrictions on the acceptance of candidates.

The volume contains a great deal of useful information and the illustrations are an improvement on the previous one. In addition there are numerous maps and figures which help to illustrate and clarify the text. A feature which still leaves further room for improvement is the index. It should be full enough to enable an administrator or historian to turn up a point of reference readily.

Nevertheless the general editing and writing of the book is deserving of the highest praise.

H. R. M.

TEXT-BOOK OF PHARMACEUTICAL CHEMISTRY. By Bentley & Driver, revised by John Edmund Driver. Sixth Edition. London : Oxford University Press. 1955. Pp. 751. 55s.

"Bentley and Driver" has been for many years a very useful text-book on the chemistry of drugs listed in the British Pharmacopœia, suitable for those studying for examinations in pharmaceutical chemistry and others concerned with the chemistry of drugs. A new edition of the B.P. has called for a revision of the book, and this has been ably carried out by Dr. Driver.

The general lay-out of the book follows previous editions, but the contents of the various sections have been altered. For example, chromium salts are omitted but helium is added; simple heterocyclic compounds have a section to themselves instead of being mixed with the section on alkaloids. Elementary analysis of inorganic compounds ("group tables") has been replaced by a description of some of the organic reagents used in testing for metals. Sections such as that on the vitamins and synthetic medicinal chemicals, together with other sections have been rewritten or brought up-to-date.

The book is well written with good clear printing, free from any obvious errors and very easy to read.

S. E.

SITES OF INFECTION. By Alan Mozley, D.Sc., Ph.D., F.R.S.E. London : H. K. Lewis & Co. Ltd. 1955. Pp. 84+x. Illustrated. 9s.

Dr. Alan Mozley has published a fifth handbook on the subject of disease-bearing snails, entitled *Sites of Infection: Unstable Areas as Sources of Parasitic Diseases, Schistosomiasis and Fascioliasis*.

The author reminds us that the parasitic diseases of man and domestic animals are limited in their distribution, and that, if the whereabouts of the parasites are not accurately known beforehand, man-made changes in their environment may lead to their sudden multiplication and the causation of epidemic disease.

The series of handbooks does not concentrate so much on formulæ for the destruction of harmful species, as on methods for the study of the organisms in all their aspects.

To assist investigators, Dr. Mozley gives some fourteen principles of ecology, to be applied when local parasites are being studied. This method, he feels may lead to the prevention of epidemics of the kind that have occurred in the past when parasites have obtained the upper hand, following suitable changes in their environment.

J. H. G.

**OPHTHALMOLOGY : A TEXT-BOOK FOR DIPLOMA STUDENTS.** By P. D. Trevor Roper. London: Lloyd-Luke Ltd. 1955. Pp. 656+xii. Illustrated. 75s.

A text-book of small dimensions cannot pretend nowadays to cover adequately the whole field of Ophthalmology, and the author has wisely stated his aims at the start. That he has covered the ground he may fairly claim, there being sections devoted to anatomy, physiology, optics and to diseases of the outer and inner eye, and the book has many attractive features, being well laid out and containing numerous excellent illustrations and clear diagrams.

The style, however, makes reading by no means easy, and simplification would add vastly to the value of the text; further, the somewhat facetious remarks to be found here and there seem out of place and would be better omitted.

A number of mistakes occur in the illustrations or their description, and it is presumed that magnification, and not dioptries, is intended in the specification of the loupe recommended on page 252. Moreover 6D of accommodative power seems rather little in adolescence.

The numbering of the illustrations seems unnecessarily complicated without facilitating ease of reference, and the index could be amplified with advantage. While there is much to criticize, including the high price, the book has much to offer and defects will no doubt be remedied in future editions.

J. B. G.

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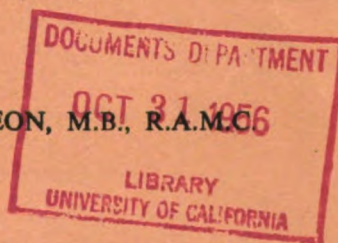
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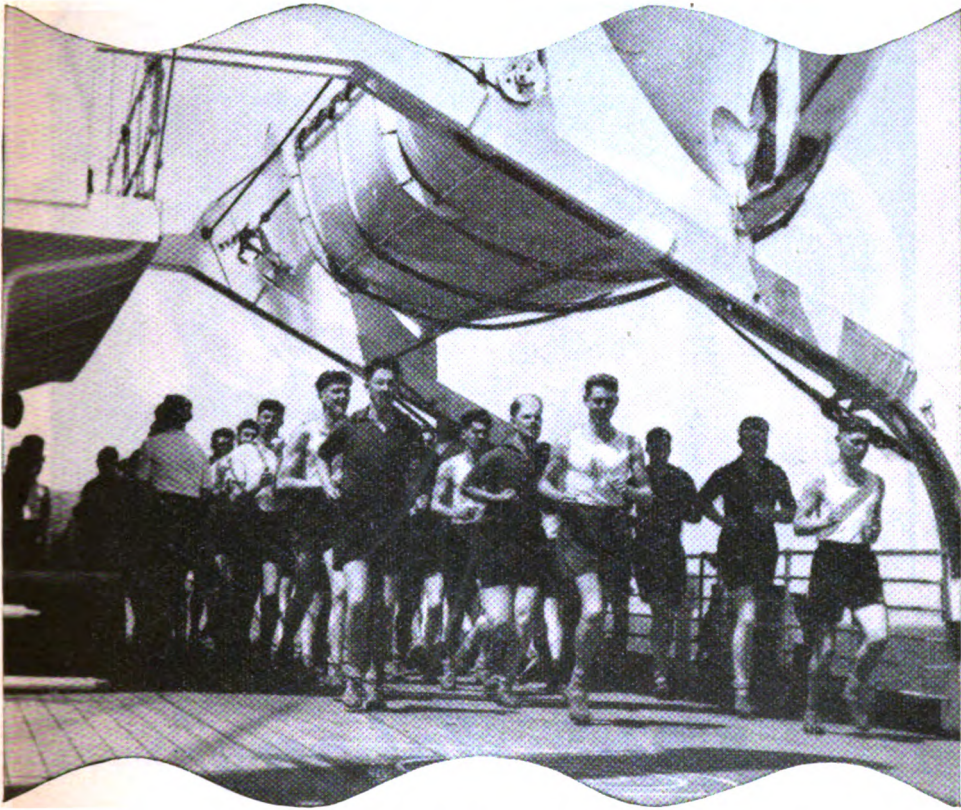
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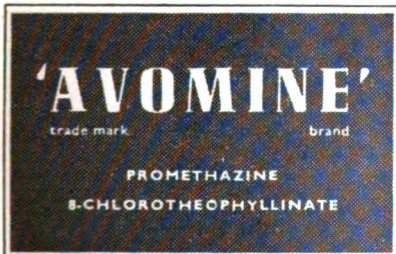
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## **THE SPINE PAD: A DISCARDED ITEM OF TROPICAL CLOTHING**

**AN HISTORICAL AND PHYSIOLOGICAL SURVEY**

BY

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### **INTRODUCTION**

THE spine pad has become a dull museum piece, and it is probable that specimens are nowadays not easy to find. Yet to those living in tropical areas during the early part of the century and to those serving with the British Army in hot climates during the First World War, memories may be evoked of a piece of cloth of cotton, silk or wool, plain or quilted, several inches wide, attachable to the shirt or coat along the spine, and sometimes with a coloured lining. It is now difficult to accept that this mere piece of cloth could in any way protect from the effects of the sun. But the purpose of the spine pad was so closely linked with the development of ideas concerning body heat, fever and sunstroke, that one must be prepared to explore many early lines of thought for an understanding of its origin and its demise.

### **SIRIASIS AND PHRENETIS—THE EFFECTS OF THE SUN**

From the dawn of history it has been recognized that rays of the sun could seriously affect the body, and early examples of sunstroke are found in the

Bible, in Greek mythology and in Chronicles of the Crusades. The term "siriasis" has been used since the time of Pliny to denote, in general, maladies arising from exposure to the great heat of the sun during the summer solstice when the dog star Sirius shone brightly in the sky. Stephen Blancard, in his *Physical Dictionary* of 1693 (7), defined siriasis as an "Inflammation or rather Heat of the Brain or its Membranes occasion'd by the Heat of the Sun. This is frequent in Children because of the Thinness of their Skulls." The word "phrenitis" was employed from classical periods onwards to denote almost any disorder of the brain associated with excitement or frenzy. After the Middle Ages it frequently became associated with maladies arising from exposure to the sun.

At the beginning of the eighteenth century the Dutch physician Boerhaave wrote on the post-mortem findings in cases of sunstroke. "The true phrenitis," he said, "is from lying with the head to the hot rays of the sun . . . such as died from the phrenitis and were open'd after their decease, had their meninges inflam'd ; a gangrene, imposthume and a sphacle of the Brain, or some sharp corroding and ichoriatic matter" (8). For almost a century after this, sunstroke was often confused with apoplexy, but it was generally agreed that in hot climates the important causal factor was the sun or wind.

In 1826 John Davy, brother of Sir Humphrey Davy and assistant director of army hospitals, investigated the ability of the sun's rays to penetrate the cranium. He noted that "when the sun's rays are concentrated by a lens, they penetrate . . . through bone, as a portion of the cranium ; through nine folds of black crepe ; and what is more extraordinary, through rolled platinum. It was easy to ascertain their penetrating through the former substance by a luminous point appearing on a surface beneath. This circumstance may help to explain the effect of the sun on the brain, in producing the malady commonly called coup-de-soleil" (20). It is clear that Davy used a dried skull bone in his experiment, and his results were hardly applicable to a living cranium covered with skin and hair. These findings of Davy's may, however, have turned the thoughts of tropical practitioners to the necessity of protecting the head from the sun's rays.

#### THE "HAVELOCK" OR WHITE CAP COVER AND NECK CURTAIN

The value of a white colour for reflecting solar heat can be traced to the physiologist John Mayow (1674) (57). By 1744 the French Army surgeon De Meyseray was already putting this into practice in the form of white leather helmets. Discussing the effects of the sun's heat, he noted that "these dangers can be prevented by the use of white leather. Experience has shown that white bodies have the property of reflecting the sun's rays, and our white leather will be sufficiently impenetrable to these rays to prevent those unhappy accidents the fatal outcome of which we have too often noted" (59).

A few years later Benjamin Franklin made the phenomenon more widely known. "Walk but a quarter of an hour in your garden," he enjoins, "when the

sun shines, with part of your dress white and part black ; then apply your hand to them alternately ; you will find a great difference in the warmth. The black will be quite hot to touch . . . Summer hats for men and women should be white for repelling that heat which gives head-ache to many, and to some the fatal stroke that the French call *coup-de-soleil*" (29). In 1787 the British Army introduced for tropical use a white felt top hat ornamented and cocked according to pattern, and on and off after this the black shako had a white linen cover (32). Robert Jackson, an early reformer of army hygiene, said in 1791 that for Jamaica "round white hats would be a proper covering for a soldier's head" (46). It is, however, not clear that these were always worn to keep the soldier's head cool. Bache, in 1836, showed perhaps for the first time that the effect of a white colour applied mainly to solar heat, and colours made but little difference in reflecting the non-luminous rays of the animal body (3).

From earliest times fear of the sun's rays must have sometimes urged the soldier or traveller to wear down the back of the neck a white handkerchief or handy piece of cloth. The official introduction of a neck curtain, however, appears due to Sir Henry Hardinge, who, in 1842, prior to leaving for India as Viceroy, ordered white cap covers for tropical use, to which was added some time later a white neck curtain (65). Within a few years the Sikh wars had broken out, and old prints of battle scenes show that a white cover and neck curtain for the shako and forage cap were in use at the battles of Ferozeshah (December, 1848) and Mooltan (January, 1849) during the hot days of the winter season (53), (37). At the battle of Ferozeshah, General Gough noted that the British soldiers "were clothed in ordinary scarlet uniforms, blue trousers, and wore forage caps covered with white cloth and a curtain hanging down behind for protection of the head and neck . . . greatcoats were not carried" (37). In 1852 Assistant Surgeon Lamprey, of Her Majesty's 15th Regiment in Colombo, recorded the results of his experiments in an obscure pamphlet entitled "*98° or 130°, or the Infantry Soldier in the Tropics*". At this early date Lamprey was using a thermometer for measuring the temperature inside clothing and headgear. The results led him to conclude that a white cover to headgear would keep the cranium cooler in a hot climate. However, he made no mention of a neck curtain (51).

Old prints demonstrate that by the time of the Indian Mutiny the use of a neck curtain was fairly widespread. The frequent use by General Havelock of the combination of a white cap cover and neck curtain no doubt led to his name being associated with this form of headgear. Both officers and men of Neill's "Blue Caps" wore neck curtains at the storming of the Char Bagh battery and at the relief of the Presidency (83). Records of the "King's Own" contain the following order of 1858 : "Wicker helmets covered with white cotton to be worn with puggarees with ends hanging down as a curtain" (19). Reference to the early interest in the neck curtain by the French Army is given by Martin, who in 1859 (56) noted that Scouttanten of Algeria was at that time pre-eminent among French physicians in urging the necessity for its use. Judée in 1863 (49) was instrumental in introducing the *couvre nuque* or neck curtain into the French Army. Morache wrote in 1874 : "Recently the cap and white neck

curtain have become regulation, but this happy addition is not sufficient. The idea was first introduced by the British Army into its uniforms" (62). The German military hygienists, Roth and Lex, were, like Morache, great admirers of British clothing and equipment, and in 1877 commented on the *Nackenschurz* or neck curtain as follows : "The simplest protection consists of the white cover and neck curtain of the forage cap. This was first used in 1842 by English troops serving in India" (69). In 1899 Captain Freeman, R.A.M.C., in his *Sanitation of British Troops in India* (30) noted that "a quilted curtain at the back of the neck has sometimes been used on service, but it is very heating to the neck." Nevertheless a neck curtain of a grey or khaki colour continued to be used by the British Army in most tropical campaigns.

In the official history of the Medical Services in the First World War, the following is found concerning the campaign in Mesopotamia : "Slouch hats had been provided with puggarees and neck curtains . . . The slouch hats were, however, replaced by tropical helmets. Steel helmets were also provided with covers and neck curtains" (86).

#### PHYSIOLOGY AND PATHOLOGY OF THE SPINAL CORD : EARLY NINETEENTH CENTURY

During the beginning of the nineteenth century doubt began to be cast upon the apoplectic nature of heat stroke. Lindesey, in 1835, noted that "the train of symptoms no doubt much resembles that of apoplectic seizure, but the post-mortem appearance far more resembles that in asphyxia from the poison gases" (52). A year later Russell added that "the brain was healthy in all cases ; no congestion or accumulation of blood was observed . . . but in all three cases the lungs were congested even to blackness throughout their entire extent" (70).

Although pathologists were in general doubting the importance of the brain as the prime seat of sunstroke, experimental work and clinical observations were reaffirming its importance in body heat regulation and in fever. The early studies of Benjamin Brodie concerning the effects of spinal section in animals were published in 1811 (9) and 1812 (10), and produced the conclusion that the nervous system was the source of animal heat. For this work he was awarded the Copley Medal of the Royal Society. However, the conclusion was soon criticized by his teacher, Sir Everard Home (44), who stressed that although injury or disease of the brain or spinal cord could induce fever, these parts of the nervous system were not the main source of animal heat. Chossat (18), in France, stimulated by Brodie, continued the latter's investigations, but inferred that the seat of heat production was the sympathetic nerve which lay on either side of the spinal cord. Claude Bernard (1857) (5) suggested that destruction of the sympathetic nerve caused vasodilation and an increase in local heat production, but his colleague Brown-Séquard (12) reasoned that the results could be explained entirely on circulatory changes. Practitioners in hot climates were not slow in applying the new physiological concepts to the pathology and prevention of sunstroke—a condition long known to be associated with an ardent fever and a burning skin.







[From "Crown & Company," Major A. Mainwaring

Fig. 1. Mooltan : the Assault, 1849

Two officers are seen wearing white cap covers and white neck curtains. A dark neck curtain is also seen.

On the clinical side, Brodie (1837) (11), Billroth (1868) (6) and Hutchinson (1875) (45) demonstrated that although in men the results of a spinal cord injury were equivocal, pyrexia and hyperpyrexia sometimes resulted. It was becoming clear that the brain and spinal cord were in some way concerned with body heat regulation. Aitken, Professor of Pathology at the Army Medical School, in his *Handbook of the Science and Practice of Medicine* (1858) (1), quoted Army Surgeon Marcus Hill of India, who two years previously had found compression of the medulla oblongata in cases of sunstroke and who had suggested that such a lesion was the cause of the pulmonary congestion.

#### DEVELOPMENT OF THE SPINE PAD : NINETEENTH CENTURY

Neither Aitken, Martin nor earlier tropical practitioners mention the necessity of protecting the spine against the sun, and no evidence has been found for the use of a spine pad of any sort in tropical campaigns up to and including the Indian Mutiny. In 1858 Julius Jeffreys noted that, "although the head is undoubtedly by far the most sensitive part of the body, the spine is also sensitive" (48). Jeffreys believed the abdomen was also affected by the sun and advised a sun curtain for its protection. He was, however, doubtful of its practical value and concluded : "It is freely admitted that a question may be raised whether a front curtain can be so suspended as not in the smallest degree to interfere with the evolution of the musket" (48).

Jeffreys spent some thirty years in India, holding appointments as Staff Surgeon at Cawnpore and Civil Surgeon at Futtehguhr. He was a personal friend of Martin, to whom his *British Army in India* was dedicated. In this book Jeffreys put forward the novel concept of body heat loss by radiation, evaporation, conduction and convection. For protection of the spine he suggested as follows : "We may suspend behind it, at a distance of some inches, an apron or curtain composed of two or three layers of Jean or other doubly woven linen or cotton cloth. We can certainly reduce the solar influence by half by this means. But there is no reason why we should rest satisfied with materials so deficient in virtue. Why should we not determine to command a bright metallic surface?..." (48). Although some of Jeffreys' ideas were highly impracticable, his views on the possible value of metalized fabric for reflecting heat were revolutionary. For many years he tried to persuade the East India Company to put his inventions to the test, but without success. When eventually tried in India, they were a failure (65). The suggestion of Jeffreys—now almost a century old—for a "climatic" chamber trial of his invention is, however, a remarkable example of a designed experiment. "Happily," he said, "it is not necessary to account for a comparative trial in India. By means of two planished tin or other metal mirrors, rays of an open fire may be reflected upwards to the ceiling and then down again. Two men may be placed side by side as to be subjected to them equally. One may be clad in the usual manner and the other in the manner proposed. It will soon appear which of them is drawn away from his post. The men may then be dressed in succession."



Another name in the early history of spine protection is that of Surgeon (later Surgeon-General) Moore of the Bombay Medical Service, who served in the Mutiny with the Rajputana field force. In 1862 he wrote that "the sun exercises as injurious an effect on the organic sympathetic system through the medium of the spinal column and the solar plexus . . . as it does on the brain . . . and this has been observed by many medical officers. Hence the importance of a turban shading the upper part of the medulla spinalis and of a cummerband worn round the loins" (61). Some time earlier Moore [quoted by Gordon (35)] suggested that good spine protection could be obtained by prolonging the neck curtain down the back and tucking it in at the waist. Although in India the villagers normally had no head cover, native soldiers were to be seen with a prolongation of the turban flowing over the shoulders, the whole back or even extending as far as the knees. European observers had looked too often for a physiological function in the dress and customs of the indigenous inhabitants of hot climates and they may have sometimes assumed that either the turban or its curtain was worn by natives for the protection of the head or spine. It is, however, doubtful whether the custom had anything but an ornamental value. Indian women did not wear a turban.

Parkes wrote in 1864 : "It is quite possible as usually assumed that, with a bad head-dress, the heat of the skin and bones or even the nerve centres of the brain and spinal cord may be greater than accord with a perfect temperature of the body" (65). Army Surgeon Gordon stated in 1859 (35) that the proximate cause of heat stroke was a loss of balance between the cerebrospinal and sympathetic nervous system. In his text-book published in 1866 he added the following : "There are many medical officers who with the author believe that on the march or during great exposure to the sun, more danger exists of heat apoplexy occurring in consequence of direct solar heat upon the loins, giving rise to spinal congestion, than from the effects upon the head. During the Mutiny in India, not a few officers suffered in this respect while sitting in the saddle during a day's march in a westerly direction, that, of their own accord, they had recourse to a cummerband, or girdle of thick folds of cloth ; and with good results. This may account for the native Indian habit of wearing large masses of cloth round the loins. In the case of horses in India, their keepers, while leaving the heads of the animals uncovered, invariably place carefully upon their loins several folds of horse cloth which they usually carry with them as if for this purpose" (36).

In spite of continued preoccupation with the effects of the sun on the head and back, practitioners in India and elsewhere had often reported the fact that sunstroke (insolation, heat stroke, coup-de-soleil) could occur out of the tropical sun—at night, in barracks and tents—and in hot furnaces and stoke-holds. Furthermore these expressions were sometimes used loosely to mean almost any effect of the sun, including sunburn and even prickly heat. Severe sunburn was also known to occasion an "irritative fever," and this may have helped to confuse it with sunstroke.

Professor Wood of Philadelphia realized as early as 1863 (80) that sunstroke was, in the main, a disturbance of temperature regulation, and as a

consequence introduced the expression "thermic fever." From his later researches on animals (81) he concluded that sunstroke arose from general overheating of the body, and stressed perhaps for the first time that selective heating of the head was not the essential cause. Little notice, however, was taken of this important finding for some thirty years.

Sir Joseph Fayrer was present at the siege of the Presidency during the Indian Mutiny, and may have seen Neill's "Blue Caps" wearing the "Havelock." In 1875 he was attached to the suite of Edward Prince of Wales during the tour of India. In his *Recollections* Fayrer gives the following entry concerning the Prince of Wales's party: "all are provided with light clothing and with quilted pads along the spine" (26). A member of the Royal Family thus wore spine protection thirty-five years before it was officially introduced into the British Army. In the *Practitioner* of 1876, Fayrer wrote that "heat stroke is due to syncope and a shock-like condition in which, from the direct action of heat on the brain and cord in exposure to the sun's rays, the nerve centres, especially the respiratory centre, are implicated causing rapid failure of respiration and circulation" (25). In 1875 Koester, looking for post-mortem changes in the nervous system in a case of heat stroke, found hæmorrhage into one superior cervical sympathetic ganglion and swelling of the other (50). Another mention of the nervous system in heat stroke, but as so often on clinical grounds only, was that of Preston (1887) (67), who stated that the condition was a specific meningitis arising from sun exposure. In 1897 Déjerine demonstrated microscopic changes in the blood-vessels and ganglion cells of both the brain and spinal cord in heat stroke (21).

Andrew Duncan, surgeon in the Bengal Army, published in 1888 a text-book on military medicine (22) which had won for him the Parkes Memorial Prize for 1886. This book is still of great value to the student for the details given of hygiene during various military campaigns. Talking of sunstroke, he noted that "the spinal cord, according to Moore, is always largely implicated. A thick woollen spinal pad must be worn sewn into the coat. This is only rarely observed in the campaigns, but I hold the protection of the spine in hot climates to be of equal importance to protection of the head. In the Afghan War, I observed only a few in use among the officers and none among the men." The use of a spine pad was, at this time, probably not a question of regimental regulation, and this item of tropical clothing was still not to be officially introduced into the British Army for some twenty years.

In the first edition of his text-book of tropical medicine (1898), Manson wrote that "a pad of cotton sewn on to the coat is a wise measure adopted by experienced sportsmen in India" (54). In the following year, Hobhouse in his *Medical Handbook of Travel* commented as follows: "Some recommend the wearing of a spine pad . . . For those who are likely to have long marches, they may be advantageous" (42). In 1903 Harford, on the other hand, noted that "a spine pad though recommended by some, is hardly necessary . . . and Sir Harry Johnson says it collects perspiration" (38). Attention having been drawn to the necessity of protecting the back, it is not surprising that "spinal"

symptoms should have developed. Thus Giles (1904) commented : "Many persons are wellnigh as sensitive to insolation of the spine as of the brain, and suffer at once from the exposure of the back to the sun's rays . . . many find that the sun playing on this part of the person causes a dull heavy aching, an oppression rather than a pain. Persons subject to such symptoms should wear a broad pad of the same material as the coat, thickly padded with cotton-wool" (34). Nowadays the symptoms would no doubt be accepted as psychological and ascribed to fear of the sun. The physicians were undoubtedly much to blame for "spinal insolation."

### THE ACTINIC THEORY OF SUNSTROKE

At the beginning of the twentieth century attention was being devoted to an actinic theory of sunstroke and to its prevention by the use of coloured linings. For an understanding of this strange chapter of tropical hygiene and the confusion surrounding it, some further ideas concerning the effect of colours on the body must now be considered.

In 1744 John Mitchell of Virginia, in his long essay "Causes of the different Colours of People in different Climates" (60), suggested that the immunity of negro skin to sunburn and prickly heat was not due to its colour "which retains more Heat than a white one, but to a Concretion of its Vessels and Glandules which renders the Skin both thicker and denser."

Within two years of the discovery of "invisible" heat by Herschell in 1800, Ritter found rays beyond the violet end of the spectrum capable of demonstration by the "photographic" method of Scheele—the blackening of silver salts. In 1821 Sir Everard Home (43) noted that painting a white skin black gave protection from sunburn, and suggested that the black rete mucosum of the negro was the natural defence. When, like Mitchell and Franklin, he found that "a black surface absorbed heat and raised the temperature beyond any other . . . he . . . gave up the matter in despair." Writing on the same topic five years later, John Davy (20) added : "I have made experiments similar to those of Sir Everard Home, and with the same results. All the opaque colours of which I made trial, applied to the skin, whether red, orange, blue or green, have afforded protection from the scorching influence of the sun's rays equal to that afforded by black." Davy realized that Home's findings were rather misleading in that the efficient sweating of the negro skin was not taken into account ; and added, without proof, that "in the tropics, the cuticle appears to be thinner . . . so as to confine the animal heat less." Neither Home nor Davy appeared to be aware of the newly discovered chemical rays.

In 1833 Stark (76) put forward the theory that colours have a selective effect on the absorption of odours. This was passed from one book to another and led to the belief that dark clothing absorbed not only body emanations but also noxious effluvia from the air. Jaeger (47), elaborating the theory some fifty years later, believed that red garments could, in this way, produce rheumatic pains and other ills.

The first application of the knowledge of the chemical or actinic rays to man was the work of Brücke (13) on the effect of "invisible violet light" on the eye. It was, however, not until 1858 that the French neurologist, Charcot, writing on the skin erythema arising from exposure to electric arc lamps, postulated that both electric erythema and the erythema of coup-de-soleil were due to the chemical rays (17). Although an astute clinician, Charcot, like many others, used the term coup-de-soleil (sunstroke) to mean erythema solare or sunburn, and may thus, by a confusion of terms, have laid the seed of the actinic theory. Moore, in 1862 (61), was perhaps aware of the work of Davy and Charcot when he wrote the following: "When rays are absorbed by a dark surface, they lose their peculiar power and cease to be radiant and induce sunburn or inflammation. Such factors lead to the opinion that in hot climates, two colours should be used at the same time; white for the outer garments exposed to the sun's rays and dark for the underclothing to prevent rays acting injuriously on the skin." Moore may also have confused sunburn with sunstroke. It is otherwise not clear why he suggested the use of dark underclothes, since it had always been well understood that ordinary clothing, whatever its colour, was sufficient protection. No reference was, however, made to any earlier work. In 1867 Robinson (68) carried out experiments on heating the hand immersed in water (to absorb heat rays) by concentrated solar rays. He concluded that the sunburn so obtained was not due to the "calorific element," and added: "Whether or not actinic or chemically active rays or whether any active power related to electricity is the cause must be left to future research." In 1885 the German dermatologist, Paul Unna (77), showed that rays capable of pigmenting the skin existed only in the ultra-violet region of the spectrum.

The next stage in the development of the actinic theory is outlined by Andrew Duncan (23). It appears that Major F. N. Maude, executive engineer serving in India, pointed out that "no one gets heat stroke when the luminous rays possess no degree of chemical energy as in the furnace of an arsenal. The actinic rays can not only produce a superficial dermatitis with pigmentation of the skin, but can effect chemical changes under the skin. Maude showed next how dark red or yellow will intercept actinic rays, as every photographer knows. He therefore, so far back as 1885, began to use a red or yellow lining to his head covering and coat, proceeding for the same reason that photographers develop plates with the aid of red or yellow light. He found the resulting relief so great and surprising that he communicated his ideas to his brother officers, in every case with the happiest results. Maude finally submitted a report to Headquarters in Simla." It was not till 1901 that Maude published his ideas as a letter in the Indian newspaper *Pioneer*. In 1887 von Schmædel, apparently independently, came to conclusions similar to those of Maude. His ideas were published in a paper (entitled "Why are Negroes Black?") given to the Anthropological Society of Munich; von Schmædel said that "nature acts exactly like the photographer when he seeks to protect his sensitive plates from the chemical action of light . . . Pigments of a light colour neutralize the heat rays but let the chemically active pass unhindered, whereas black pigments permit heat rays to pass but stop the

chemical" (27). On this hypothesis he attempted to explain the matter vexing John Mitchell in 1744—the relative immunity of dark skins to prickly heat.

Although it is true that at the temperature of an arsenal furnace little or no ultra-violet light is produced, it has already been pointed out that heat disorders did in fact occur under such conditions. It is not clear what Maude meant by "chemical changes under the skin," but presumably they were the cause of sunstroke and related disorders. The "relief" that Maude and his brother officers obtained from protective colours was probably from some form of headache which can be nowadays explained only on a psychological basis. In 1897, Lord Roberts clearly stated that he had found coloured linings of no particular value (90).

Almost up to the end of the nineteenth century the term actinic was used rather loosely by photographers to mean any radiation capable of affecting their plates, the sensitivity of which was, at this time, almost entirely due to visible blue and violet light. Although plates were also sensitive to what is now understood by ultra-violet light, the amount produced by the light source of a dark room and passing through coloured glass must have been non-existent. Since the plates in the dark room were sensitive to visible light and the supposed cause of sunstroke was invisible rays, the analogy used by Maude and von Schmædel can hardly be said to have had a scientific basis.

In 1898, two years after the application of Röntgen rays to the human body, Manson (54) wrote: "The phenomenon connected with the Röntgen rays suggests the possibility that there may be solar rays other than ordinary heat rays which although able to pass organic materials can nevertheless be arrested by metal. If this be true for the sun as for the electric spark, a useful addition to the sun hat would be a thin plate of light metal." There was no reference, however, to the use of coloured linings.

In 1901 Captain Munson of the American Army said that "with a better knowledge of the character of light, it has been suggested that actinic rays are a strong factor in the production of insolation. This can be arrested by a layer of colour used as a filter. Dark red, yellow, or green are protective and the material or thickness is of little importance. A lining of such a colour is recommended for the head cover and for the blouse over the spine" (63). The source of this information is not given.

During the short period between reading the letter in the *Pioneer* and returning to England in 1902, Andrew Duncan, greatly impressed by Maude's ideas, put theory to practice by lining his sun hat and spine pad with orange coloured flannel and by wearing an orange coloured shirt and vest. Prior to this, he had suffered from three attacks of the sun characterized by "excruciating pain in the head coming regularly as soon as the sun had risen and lasting all day until the sun had set. Nothing relieved them . . ." However, after using the protective clothing, Duncan (like Maude) insisted that he afterwards experienced no bad or distressing effects of the sun (23). What sound conclusions can be drawn from this statement is left to the reader !

Schmidt in Germany was soon aware of Duncan's paper and at once put the

theory to scientific test. Using photographic and radiometric techniques, he carried out experiments on the transmission of solar radiation and artificial ultra-violet light through various body tissues and textile fabrics (71), (72). In 1903 Schmidt found that very little ultra-violet light penetrated deeper than the surface of skin or textile fabrics, and pointed out that in the clothed man insufficient reached the skin to produce even sunburn. He concluded that actinic rays were of no importance in sunstroke (71). Little notice was taken of this important finding for a number of years. Giles, in 1904 (34), said of children, "their little skulls appear remarkably easily penetrated by the Y or Z rays, causing sunstroke" but gave no details of these fictitious rays. In the following year Professor W. J. R. Simpson, one time Medical Officer of Health at Calcutta, noted that "the injurious effects of the sun are believed caused more by chemical than heat rays. For this reason red, orange or yellow coloured fabrics which do not allow chemical rays to pass should be worn. Natives of hot climates are fond of these colours and may have learnt from experience their comfort" (75).

Major Woodruff of the American Army, evidently unacquainted with Schmidt's results, had become a firm disciple of the actinic theory. In 1905, writing of the protection afforded by the skin of coloured races, he remarked that "all these colours indubitably enable the native to conserve heat as well as the white man, and at the same time to exclude the dangerous chemical rays. The underclothes should be opaque, and black is best although yellow will do . . . it explains the wonderful tendency to wear black clothing which we see in many hot climates. They are actually cooler than white garments of equal weight . . ." Woodruff, like Giles, reiterated in somewhat modified fashion the earlier assertion of Blancard and Davy : " . . . it is surprising how transparent the scalp and skull are to light waves" (82). Considering how much was known about the reflecting power of a white colour for solar heat, Woodruff's remarks on black clothing—based on speculation alone—show the continued confusion of ideas.

In 1908, Duncan, apparently unaware of Schmidt's refutation of the actinic theory, read a second paper on insolation (24) to a meeting of the United Services Medical Society, held at the Royal Army Medical College. Maude—now a Colonel—had been invited as an honoured guest. Duncan outlined the latter's early work, but neither Charcot, Moore, von Schmædel nor Munson received mention. The discussion after the meeting is well worthy of notice. The various theories of insolation were put forward and received a certain amount of support, but the actinic theory was generally adopted by the audience. Eloquent testimony was given as to the value of orange-red as a protective colour, and a singlet-type garment was recommended having an incorporated spine pad. The following dangerous statement was put forward by Duncan : "In the old pattern red army uniform the sun was less powerful for harm than it is with modern dress." Dr. Sambon, also of the London School of Tropical Medicine, was present at the meeting and elaborated his new bacterial theory of sunstroke, but as far as the rest of the meeting was concerned this hypothesis "did not have a leg to stand on." In the same year another paper on the actinic theory was published by Colonel R. J. S. Simpson (74). After critical examination of available

data, the author concluded that the "evidence for the theory was not always as strong as the language in which the theory was expressed."

About this period "Solaro" and "Assolar" cloths—a logical outcome of the actinic theory—were being used for tropical clothing. Both were thin materials ; on the one side khaki or white in the warp to reflect solar heat, and on the other side black, red or orange in the weft to absorb actinic rays. "Solaro" was of English manufacture. The origin of "Assolar" cloth—the German equivalent—is not known.

A year before the appearance of Duncan's second paper, Lieut.-Colonel Wood, Inspector-General of the Philippine Division, American Army, had called attention to the experience of British Army officers in India as to the value of coloured linings in the prevention of heat disorders, and had suggested that these be put to trial in the Philippines by American scientists. During the years 1909-1910 Gibbs (33), Freer (31) and Bacon (4) of the Philippine Bureau of Science carried out investigations on atmospheric ultra-violet light, and found that its intensity was most variable and sometimes no greater in Manila than in temperate zones. It was shown that it was the chemical nature of a dye and not necessarily its colour that was the absorbent factor of ultra-violet rays. Schmidt, in 1909, had independently come to the same conclusion. He also showed that there was no particular virtue in the so-called actinic proof colours of "Assolar" and "Solaro" cloths. By this time the term actinic light was losing its association with visible blue and violet light and becoming synonymous with ultra-violet rays. In 1901 Phalen (66) carried out a physiological trial in the Philippines on a thousand American soldiers wearing orange and white vests. An elaborate series of physiological measurements (red and white blood cell count, pulse-rate, blood pressure, etc.) and a questionnaire were used. The results showed, in general, no objective difference in health or physiological measurements between men wearing white and those wearing coloured garments. A series of papers was soon published by other American workers—Wickline (1908) (78), Chamberlain (1911) (16) and Aron (1911) (2). Again it was concluded that no evidence was present to validate the actinic theory. Aron's experimental work on monkeys is of interest in that it confirmed Wood's results of 1872, and showed again that selective heating of the head was of little importance in sunstroke.

In 1910 Castellani and Chalmers exposed animals with shaved heads to the sunlight of Colombo, using red glass to screen off ultra-violet light (15). Their unexpected conclusions were that heat stroke was due to the visible blue and violet rays—the actinic rays of the older photographers. Pardy-Lukis & Blackham (64) noted in 1911 that since all effects of sunstroke could be attributed to infra-red rays, elaborate precautions by way of two layers of clothing of different colours were superfluous. In the same year, Colonel Hehir (40), noted that although coloured underclothing had the advantage of not showing the dirt, the dyes used might be conducive to a number of skin disorders. Colonel Havard of the American Army was first an adherent of the actinic theory. However, in 1914 (39) he wrote as follows: "The application of non-actinic colours to the soldiers' uniform presents difficulties. Orange red is too conspicu-





FIG. 2. Mesopotamia  
Preparing a trench mortar. Soldier wearing a triangular spine pad and a neck curtain. Note attachment of pad to chest by tapes.



FIG. 3. Mesopotamia  
An advanced signal post in a trench. Both men are wearing oblong spine pads, each attached to the waist by cord. Neck curtains also worn.

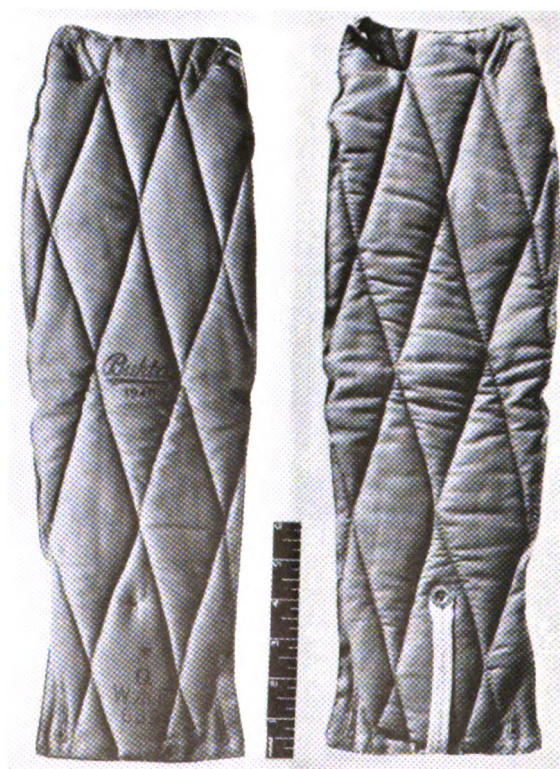




*[Imperial War Museum Photograph]*

FIG. 4. Mesopotamia

Straw mats being used as a shade for a howitzer in action in the desert. Only one man appears to be wearing a spine pad, which appears to be almost identical with the issue item of 1940. It is clear that the belt loop was not always used. Neck curtains are not seen.



*Front View*

*Back View*

FIG. 5. Spine Pad, Army Model, 1940

(Loaned by D.I.C., M.O.S., Branstor)

ous in colour to be used as a lining to the blouse or for undergarments in hot countries where the soldier is inclined to discard his underclothes. The protection does not depend only upon the colour of the fabric but also upon its thickness and the tightness of its weave."

Although the actinic theory of sunstroke had received a serious setback in the early work of Schmidt and the later investigations of the American workers, the new knowledge was to disseminate slowly ; and those travelling to hot climates continued to buy spine pads with coloured linings and to add them to their tropical kit. Furthermore, the British Army decided, at long last, to adopt the spine pad officially. In the 1909 *Regulations for the Clothing of the Army* (88), Table 8, a reference is given for the first time to "Pads, back, for European non-commissioned officers." The *Priced Vocabulary of Clothing and Necessaries* of 1911 (87) shows a similar entry. There is no evidence that the British Army spine pad ever had a coloured lining, and it does not appear that a spine pad was officially used by continental armies.

### THE FIRST WORLD WAR

In the First World War, the British Expeditionary Force went out to Mesopotamia armed with the "helmet Wolseley and pagri, chin strap, spine pad and dark glasses" (92). Perusal of the profusely illustrated *The Times History of the War* (91) shows but very few photographs in which a spine pad can be clearly seen on a soldier's back, but a number of examples are to be found in the photographic records of the Imperial War Museum. The pads were of an oblong or triangular shape (base of triangle over the shoulders) and appear to have been buttoned or clipped to the shirt, and kept in position by tapes tied round the chest or waist. Only one brief mention of the spine pad can be found in the official history of the Medical Services (86) ; but Willcox, consulting physician to the Expeditionary Force, writing later (79) of his experiences of sunstroke, accepted the value of spine protection.

Shaklee, in 1917 (73), repeated Aron's work on monkeys, and like most of the workers in Manila concluded that the only radiation of importance in sunstroke was in the infra-red region of the spectrum. Yet, two years previously, Puntoni in Italy [quoted by Byam and Archibald (14)] again insisted that the human cranium could be penetrated by ultra-violet rays. In 1918, McKenzie and Le-Count in the United States, published a clinical study of heat stroke (58). The authors stated quite categorically that no evidence existed for actinic or any other rays apart from heat rays playing an important role. Leonard Hill, in 1919 (41), repeated the work of Schmidt and showed that neither in a topee nor in a straw-board box lined with red or white material was a photographic plate affected by the sun's rays. He also concluded that actinic rays were of no consequence in heat stroke. Nevertheless, Hill (as did Parkes half a century before) suggested that local heating of the head or spine might result from sun exposure and continued to recommend the value of head and spine protection.

## THE LAST OF THE SPINE PAD

Conflicting opinions are found in the text-book on Tropical Medicine edited by Byam and Archibald (1923) (14). Balfour accepted the value of a spine pad but added that there was no special advantage in having it made of red cloth. Professor Simpson, reiterated his previous remarks on the value of coloured linings. On the other hand, some army authorities were now beginning to doubt the value of spine protection. Colonel MacArthur writing in an official memorandum (1924) (85), noted that "spinal pads are useful if only they engender a feeling of comfort and safety."

In 1930 Marsh (55), working in Persia, reinvestigated the earlier studies of Wood and Aron, and once again demonstrated that if the body of an animal was kept cool, exposure of the shaved head to tropical sun did not produce sunstroke. When the body was exposed but the head kept cool, the animal generally died, with the usual post-mortem findings. At last it was fully confirmed that sunstroke was not due to the effect of the sun's rays on the head, and critical observers suspected that neither the head nor the spine required protection. However, there is no evidence to suggest that, at any time in its long history, the spine pad was put to physiological trial under appropriate climatic conditions.

It was not to be expected that the spine pad would disappear forthwith, particularly from the British Army that had waited so long for its acceptance. In the *Official Regulations for the Clothing of the Army* of 1936 (89), the pad received the more imposing title of "spine protector," but nevertheless was but rarely used in tropical zones.

With the Second World War, the spine pad made a brief appearance. It was being produced in England in 1940, and there is some evidence that it was occasionally worn in India as late as 1942. Zachary Cope, writing in the official history of the Second World War on the subject of heat disorders, found that "there was difference of opinion as to the need of protective topees and spine pads. Some called them relics of superstition" (84).

## CONCLUSION

During the life history of the spine pad many changes were taking place in the prophylaxis of heat disorders. Over-indulgence in food and alcohol was becoming frowned upon; tight thick uniforms and strangling stocks were slowly discarded; soldiers were less often exercised in the sun or incarcerated in stifling barracks during the heat of the tropical day. Fear of the sun diminished with the realization that its rays could not penetrate into the nervous system.

Faith, magic and empirical treatment have played their role in the development of the art of medicine. In medieval times it was believed that red cloth had sympathetic attraction for blood and humours and could protect from the scars of smallpox. The magic of a red colour remained until Victorian times as the old mother's tale concerning the power of a red muffler in the cure of a

sore throat. In 1893 Finsen (28) produced equivocal evidence to show that smallpox scars did not develop when the patient was nursed in red light. At the beginning of the present century Maude, Duncan and others were convinced of the efficacy of a red or orange colour as protection against sunstroke. Nevertheless, this belief must now follow the others into the limbo of superstition.

Spine protection is no longer a subject for discussion amongst students of climatic physiology. A century-old chapter in the history of tropical hygiene is closed.

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## THE CONTRIBUTION OF WAR TO THE ADVANCEMENT OF SURGERY\*

BY

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THE privilege of knowing the late General Blackham has been enhanced by the honour the Council have done me in inviting me to deliver the second Memorial Lecture, and I am indeed grateful to them.

My first meeting with General Blackham was in 1945, when, at an age when most of us would feel that our active work is done, he was dispatched to Italy to review the situation there of medical personnel. His wide knowledge, ripe experience, and his very human approach especially fitted him for this task, and although he had already at that time passed the allotted span, he toured widely and visited nearly all our medical establishments with an exhibition of energy that would have been creditable in one of half his years. During the time of the illness which eventually laid him to rest, I saw much of him, and his fortitude and still youthful outlook during this period compelled not only my admiration, but inspired also a deep affection for him. He was active in his many and varied interests even unto the end, and one is reminded of these words from the Apocrypha : "For glorious is the fruit of good labours : and the root of wisdom shall never fall away."

The subject I have chosen is one which I dare to hope may have pleased him. Though he himself was inclined to medicine, he was always alive to the role of surgery in war, and during the Second World War contributed a most useful chart on Air Raid First Aid.

The manifold blessings of surgery, the benefit of which we reap in full measure today, owe everything to man's triumph over the dangers which beset the open wound, whether it is inflicted in war or by accident, or purposively by the surgeon's knife itself. The paramount danger, overshadowing all others, is infection by bacteria ; its chief ally is the deprivation of the vitality of the whole man, the main cause of which is loss of blood. The conquest of sepsis, the control of hæmorrhage, and the prevention or reversal of shock, have, with the great boon of anæsthesia—than which there has been no greater blessing vouchsafed to man—made possible the tremendous advances in specialist techniques which we have witnessed during our own lifetime. To the solution of the many problems, war has made a vast contribution by providing the material of experience, horrible though it is to contemplate. "I would remind you again," said the late Sir Clifford Allbutt, "how large and various was the experience of the battlefield, and how fertile the blood of warriors in rearing good surgeons."

At all periods of history, the field of battle has attracted surgeons, not only

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by reason of patriotism, but because it offers such rich opportunities of concentrated experience. "One battle," said Sir George Makins, "can afford more material and that of a more varied nature than many years of experimental work."

Before Lister made eclectic surgery possible, it was almost an essential for the surgeon to go to the wars in order to fit himself for the very restricted surgical practice of civilian life, which dealt mainly with injuries and emergencies, and the advances in surgery were due largely to the experience thus gained. Wrote Sir Clifford Allbutt in 1904: "Let us not forget how many of the greatest men in medical history, from the wars of cloud-topped Ilion to those of Greece, of Rome, and of modern times, had been in military service."

In the Trojan War, surgeons were in the nature of part-time Consultants—treating the wounded when not engaged in fighting themselves! Homer mentions two such warrior surgeons by name—Podalarius and Machaon, both reputed to be sons of Aesculapius. Their practice was confined to the treatment of penetrating wounds inflicted by spear and arrow, which, according to Homer, were attended by a mortality of 75 per cent.

In the wars of living memory most of the field surgery was performed by civilian surgeons enrolled into the R.A.M.C. for the duration only, but in times gone by many surgical pioneers were entirely, or mainly, occupied in military service, particularly in their younger days, and until their reputation and personality won the Royal favour, and perhaps a court appointment. Of these pioneers Thomas Beddoes wrote in the eighteenth century: "There exists no set of men more meritorious than the body of our military practitioners of medicine. Their ardour seems to have as much exceeded that of their brethren in civil life, as their situation has been more uncomfortable, and their rewards more scanty. It has been common among those both in the Army and the Navy, after fatigues of which we who go on so much at our ease have scarcely a conception, to employ the hours due to repose, in noting down their observations." Then he is moved to say, rather in anticlimax, "What a pity that such men are not more solidly grounded, and more highly finished by those who undertake to form their minds." The proverbially rude soldiery in fact!

Among these whole-time military surgeons of the past may be mentioned the naval surgeon John Woodall (1569-1643), who anticipated the modern treatment of gunshot wounds by advocating free drainage as opposed to "cramming them full of bole or restraining powder or some other stuff and then thrusting in pledgets or dossels into each corner of the wound"—a lesson which, I venture to say, could well be relearned today by some contemporary doctors. Woodall was the first to observe the virtue of fresh fruit juices for scurvy, a treatment to be established in the century following him by the naval surgeon James Lind, and which made Captain Cook's famous voyages practicable.

Richard Wiseman (1622-1676), whose portrait adorns the Council Room of the Royal College of Surgeons, is sometimes called the Father of British Surgery, just as his contemporary, Thomas Sydenham, is regarded as the Father of British Medicine. These two redoubtable men fought on opposite sides during the Civil War, Wiseman being the Cavalier—as perhaps better befits the surgical

temperament ! Wiseman saw service in the Dutch navy before the war, and the Spanish navy after it, until the Restoration, when he became surgeon to King Charles II. His main contributions were to advance the technique of amputation and to give the first adequate description of tuberculous disease of joints.

Much time could profitably be expended on examining the lives of other pioneers in similar circumstances whose observations were painfully recorded under the extreme privations of military service which then prevailed—observations which became absorbed into the sum total of our knowledge. Perhaps the greatest military surgeons of all time were Ambroise Paré (1510-1590) and Baron Dominique Jean Larrey (1766-1842), both of whom were Frenchmen.

Paré, who took part in military operations intermittently over a period of thirty years, is immortalized by the phrase which graces his statue. *Je le pansay et dieu le guarit* embodies the outlook which led him to abandon the aggressive treatment of wounds then current, in favour of conservatism.

Baron Larrey accompanied Napoleon in all his campaigns, and was present at some sixty battles and 400 minor engagements. Of him his Emperor remarked, "*C'est l'homme le plus vertueux que j'ai connu.*" Larrey enjoyed enormous prestige, based on the devotion to him of the common soldier, many of whom, it is recorded, sacrificed their own lives so that his might be spared. He thought nothing of waking up a general in the dead of night if any question of the welfare of the troops was at stake. Those of us with experience of the military hierarchy will appreciate what this implied ! Apart from his enormous contributions to the advancement of surgery, we must honour him for setting a shining example of fearless and selfless service to those fallen in battle. The British equivalent of Larrey was James Guthrie, who at Waterloo successfully amputated at the hip-joint, and successfully used the ligature for the arrest of hæmorrhage.

I should also like to include amongst this select few the name of William Beaumont (1785-1853), the United States army surgeon, not only because it gives me an opportunity to pay homage to our surgeon colleagues in the American armies, but also because I have a great admiration for this American army surgeon. The knowledge we have today of the physiology of the stomach is largely due to his sustained observations, published in 1833, upon a gastric fistula, which resulted from a musket wound suffered by the Canadian half-breed Alexis St. Martin.

Among the more peripatetic military surgeons of the past we may mention the great John Hunter, who saw service with the expedition to Belle Isle and in Portugal. It was during these campaigns that he gained the knowledge on which was founded his greatest works. Others of note were Sir Charles Bell, who was present at Corunna and at Waterloo, and his brother John, and more recently Sir William MacCormac, who saw service in the Franco-Prussian War. It may be of more than passing interest that of these volunteers for warlike activities, three came from North of the Border and the fourth from Northern Ireland !

But warfare in modern times has contributed to the advance of knowledge not only by offering the raw material of surgery in great, often appalling, abundance, but also in an abstract way, which all of us have experienced, but would

not find easy to express. There is a heightening of perception, a singleness of purpose, an urgency impelled by the public conscience, and indeed by the very struggle for national survival itself. All processes of discovery, research, invention, are pressed forward at speed in all the sciences, and not least in surgery.

The leisurely pursuit of knowledge characteristic of and admissible in peace time is replaced in modern war by an intensity of effort, not confined to surgeons in the field, but shared equally by the civilian surgeons at home, who were in the last war sometimes exposed to dangers even greater than were their military confrères. For all of us were soldier surgeons as indeed we were civilian soldiers, whether or not we were privileged to wear the King's uniform ; whether we were in the field, or in hospitals or research units at home or abroad.

Many outstanding examples of the rapid solution of problems under the stress of war come to mind. As a result of the experience of the South African War one recalls Lieut.-General Sir William Leishman's successful campaign against typhoid, which disease was far more predatory than were Boer bullets. The First World War provided many such instances. As an example may be cited the problem of tetanus, or lockjaw. The mortality from this infection in civilian life in the earliest days of the century was between 70-85 per cent., and it was then regarded as a calamity to be reported and deplored. The high incidence of tetanus amongst the wounded in the holocaust of the First World War stirred the War Office into swift action and Sir David Bruce was instructed to set up an inquiry. The story of the energetic steps taken, and the manner in which this task was successfully carried through makes a worthy chapter in the annals of the Army Medical Service and is a lasting tribute to its organizing capability.

The known incidence of tetanus in France in the early days of the 1914 war was 1.47 per 1,000 wounded, though in fact it probably exceeded this figure. In one month (September, 1914) it was 8.8 per 1,000. The mortality from it in 1914-15 was 78 per cent., in 1919 it had fallen to 15 per cent. In the Italian campaign of the last war, 96,164 United Kingdom and Commonwealth soldiers suffered wounds. Only 31 of these developed tetanus, and 22 of them recovered completely.

The intensity of effort, so noticeable a feature of the First World War, reached new heights in the Second World War, and under the stimulus of events, and sustained by the pooling of the vast resources of the Commonwealth and of the great Republic of the United States of America, advances in the whole broad field of surgery were as great as mankind had ever witnessed in any decade of history. The momentum of that forward surge has not to this day been expended.

## WOUND HEALING

Since the beginning, the main preoccupation of the surgeon has been the healing of wounds. It would indeed be true to say that the history of surgery is largely the history of wound healing. It is necessary to recognize this in order fully to appreciate the magnitude of the contribution that Lister made, for until

his time even the wound of the surgeon's knife exposed the patient to such dangers that deliberate open surgery was rarely justified except as a last resort. Lister's old teacher, Sir John Erichson, had remarked that surgery was approaching, or had even already attained, something like finality of perfection, and insisted that it would never be safe to operate on the abdomen, the chest, or the brain. It thus befell that most surgery before Lister was the surgery of injury—and one of the commonest operations was that of amputation, itself an acknowledgment of failure. The mortality was frightful. Although all the problems of wounds were not solved even when antiseptic treatment was accepted and established, yet all surgical advances of modern times take their root from the Listerian concept. As we shall see, however, the later Middle Ages provided for an epoch, a standard of surgery which, taken against the background of the knowledge of that time, rivals that of the twentieth century.

But much that military surgery had taught us had already been forgotten before Lister—indeed it can be argued that something akin to antiseptic surgery was practised empirically many years before the birth of Our Lord, and one recalls how the good Samaritan “had compassion on him, and went to him, and bound up his wounds, pouring in oil and wine, and set him on his own beast, and brought him to an inn, and took care of him.”

The great controversy before Lister centred around whether the formation of pus in a wound was a favourable or an unfavourable sign, praiseworthy or to be deplored. Since at least the days of Galen (103-201), with certain notable exceptions, the development of pus was regarded not only as favourable, but as an *objective* of treatment—hence the term “laudable pus,” which term some attribute to the Arabian School of Medicine; it survived until the latter half of the last century. To stop primary hæmorrhage and to promote pus, wounds were treated initially with boiling oil, or the actual cautery, proceedings which must have been responsible for untold suffering. There was a temporary break away from this cruel practice in the thirteenth century, which marks a luminous page in surgical history. The stimulus was provided by the later wars of the Crusades.

The Crusade surgeons were called Knights Hospitallers, and their organization may be regarded in some sense as the forerunner of the Venerable Order of St. John of Jerusalem, of which General Blackham himself was a distinguished member. The Knights Hospitallers were mainly Italian and French, and, as the American historian James Walsh puts it, brought back with them from the wars a magnificent accumulation of practical and scientific information on surgical matters which was very soon made available for their civilian colleagues in civil life at home. As has so often been the case in all forward movements, a great personality emerged to promote and chronicle the advances of the time. In the thirteenth century such a one was Teodorico Borgognoni, better known as Theodoric, Bishop of Cervia (1205-1298), a surgeon and son of a surgeon, whose knowledge of the surgery of his period is contained in his *Treatise on Surgery* completed in 1266, the first edition of which appeared in Venice in 1498. Like Lister, he was reviled by his contemporaries because he dared to challenge the dogma of laudable pus, and to champion the aseptic management of wounds.

"For," he says, "it is not necessary that pus should be generated in wounds. No error can be greater than this. Such a practice is indeed to hinder nature, to prolong the disease, and to prevent the conglutination and consolidation of the wound."

"In principle what more did Lister say than this?" comments Sir Clifford Allbutt.

It was about this time that the terms "healing by first intention" and "healing by second intention" were coined by the contemporary surgeon Brunus, of Verona and Padua.

Theodoric followed the teaching of his father Hugo, who "dressed all wounds with wine and flax and a properly arranged dressing, making them heal solidly as before, and succeeded in obtaining very beautiful cicatrices without any ointment." He cleansed the deep wounds with wine, scrupulously removing all foreign particles, and using the hitherto despised ligature for bleeding from the deep vessels. He also anticipated modern views by insisting upon the importance of good nutrition of the patient as the best possible basis for good surgery. His treatment of compound fractures recalls the introduction after the First World War of what was known as the Winnett-Orr method, and in the Spanish War the method of Trueta. "The bandaging should be rather simple, and a compress should be placed over the wound moistened with warm wine. This should not be touched for ten days, and the whole limb should be washed off with warm wine." Depressed fractures of the skull were treated by gently removing the loose fragments of bone. His views on abdominal wound treatment are remarkably up to date. But in spite of these sane and practical, and indeed scientific methods, in which Theodoric was supported by his pupil Henri de Mondeville (1261-1320) and later by Paracelsus (1493-1541), who was so violent a reformer that he publicly burned the books of his contemporaries as an expression of his contempt for them, surgeons reverted to the cautery for initial wound treatment, and continued to insist upon the virtues of pus formation.

It was not until the time of Ambroise Paré some three centuries later that there was a return to conservatism. During this interval, gunpowder had been invented and employed in warfare, and wounds of a more devastating nature resulted. Everyone is acquainted with the story of how Paré, when in Turin, ran short of "oil of elders, scalding hot," which was a then recognized primary application to wounds. As a result he was forced to apply a "digestive of eggs, oil of roses, and turpentine." That night he could not sleep, fearing that he would find that these patients were dead in the morning. He rose early, and to his great surprise those who had been dressed with the "digestive" had little pain, while those to whom oil had been applied were "feverish, with great pain, and swelling of the wounds."

The rational management of wounds was still, however, to wait for a further 300 years and the coming of Lister, whose methods were first tried out in battle in the Franco-Prussian War of 1870 by Sir William MacCormac, with what success I know not.

The greatest test ever to confront surgeons in wound treatment came, of

course, with the First World War, with the combined horrors of high explosives and the heavily infected soil of the Western front. Strong antiseptics were proved inadequate, and the "physiological" treatment of wounds advocated by Sir Almroth Wright, one time Professor of Pathology in the Army School at Netley, and later the predecessor of Sir Alexander Fleming at St. Mary's Hospital and associated with that surgical "débridement" well known to Baron Larrey. By 1917, the achievements in early wound healing had reached a very high standard.

In the Second World War, much of what had been learned was forgotten, and had to be relearned by the younger surgeons, until by judicious forward surgery, followed by the delayed suture of wounds three to four days later at base hospitals, the problem was all but solved. The chief event in this connection, however, was the advent of penicillin.

The discovery of penicillin by the late Sir Alexander Fleming dates back to 1929, but passed almost unnoticed at the time. Its exploitation as a therapeutic agent began only in 1940, and developed, as Garrod has put it, into one of the most remarkable achievements of the war period. Its assays in actual warfare began in Egypt in 1943, and were continued on an ever-increasing scale in North Africa, Sicily and Italy,\* where its remarkable powers, if correctly used in conjunction with adequately organized forward and base surgery, were made manifest. This great achievement was due primarily to Sir Howard Florey and his co-workers at Oxford, who had embarked even before the war on the study of anti-bactericidal substances of living origin. To such substances the term "antibiotics" was applied by the American Waksman in 1942, though the expression antibiosis was first used by Vuillemin in 1899 to describe the process whereby "one creature destroys the life of another in order to sustain its own."

To try to recapture for a moment the spirit of the exciting days of the birth of penicillin as an effective antiseptic agent, let me quote Major-General L. T. Poole, then Director of Pathology at the War Office. He wrote :

"At that time (1942) communications with the Middle East were most uncertain, but the difficulties were overcome and the penicillin sent by air, and in November, Professor Florey wrote 'I have heard that you have received some penicillin from us in good order and that it has been used on at least one case with some encouraging results.' " The full report from the Middle East by Major Pulvertaft (1943) dealt with the treatment of 15 patients and confirmed the worth of penicillin in the control of sepsis.

The production of penicillin in bulk was the next obstacle, and that it was surmounted in such extraordinarily quick time was due to the enthusiastic co-operation of the United States, though its use, thanks to the willing forbearance of the civilian populace at home, was restricted to the wounded for a considerable period. By 1944-45 sufficient supplies were available for local application to all wounds, and for parenteral administrations in the more serious of them, although the supplies still had to be controlled, and indications for use laid down in a directive. I well remember how on one occasion one courted

\* Penicillin was also used in Burma.—Ed.



displeasure by supporting a medical officer who rightly and boldly refused to give from his meagre supply some penicillin demanded by a very high ranking combatant officer for treatment of his sinus trouble !

As a result of good surgery—for which no antibiotics can substitute—coupled with the use of penicillin, primary healing of wounds of limbs sustained at the battles of the Senio River and the Po Valley towards the end of the Italian campaign were as follows :

	100-90% healing	89-50% healing	Under 50% healing
With fracture (298) ... ..	240 (81%)	49 (16%)	9 (3%)
Without fracture (1,555) ...	1,380 (89%)	152 (9%)	23 (2%)

The results at one hospital on the line of communications which was reserved entirely for the purpose of delayed primary suture of limb wounds were even better, for 90 per cent. healing was obtained in 98 per cent. of 624 patients with flesh wounds, which illustrates the value of good administration and segregation.

The awful bugbear of the chronically infected wound had indeed virtually disappeared from the scene of battle. Full credit is due to the Administration, which at the time of which I speak was under the direction of Major-General W. C. Hartgill.

The benefits of penicillin did not, however, end in its immediate application, for its success stimulated the search for new and more potent substances of similar type. In 1944 streptomycin appeared, followed at intervals by aureomycin, terramycin, and others, which already have passed into the realm of lay familiarity. Few indeed are the bacteria which now can flourish with impunity in the human body. The fear, however, which haunts the medical world is that these substances may only hold sway over bacteria for a limited span of time, for already there is evidence that new and resistant strains of bacteria are appearing.

### BLOOD TRANSFUSION

Let us now turn to the other great problem, the resuscitation from, and prevention of, shock. Chief among the causes of shock is blood loss, and it follows that replacement by whole blood is the chief instrument of treatment.

Blood transfusion today is commonplace, but it is an entirely modern development, since it has only become established as a practicable procedure during the last thirty years. Many of us here tonight well remember how rarely it was employed in our student days. Even in the late twenties blood transfusion was quite a major and exciting undertaking.

As Sir Geoffrey Keynes reminds us, however, the idea of blood transfusion dates back to the early sixteenth century, and the first recorded animal experi-

ments were carried out by Dr. (later Sir) Christopher Wren about the year 1660. The first transfusion of human blood into a human being was probably performed by Blundell and Cline in 1818.

The possibility of blood replacement by transfusion in the field of battle was countenanced and practised in the 1870 war, but progress was slow owing to clotting and to ignorance of blood grouping, for human blood is not universally compatible.

The matter was reawakened by the experiences of the First World War, when the casualties exceeded anything that had ever been contemplated, and great strides forward were made in technique. Blood transfusion was first used on anything like a set scale at the first battle of Cambrai (1917), though it was still something of an event, and troubles due to incompatibility were commonly encountered.

Between the wars we owe the concept of the giving of blood as a social service, and indeed also the birth of such a service, to the late Mr. Percy Lane Oliver, Hon. Secretary of the Camberwell Division of the British Red Cross Society. It started when he was asked on the telephone by my late colleague Dr. Edward ffliott Creed, of King's College Hospital, if he could find among his Red Cross workers a donor to give blood for a patient who would otherwise die. Oliver rose to the occasion, and the life was saved.\*

Continuous drip transfusion was introduced in the middle thirties by Drs. Marriott and Kekwick of the Middlesex Hospital, one of whom was later to become a Brigadier Consultant, so that when the 1939 war came transfusion was already an established practice, though several problems remained to be solved.

The need for stored blood both for home consumption and for troops in the field was at once recognized, and an organization was set up, which, to my mind, was one of the major triumphs of the war period, and which set a standard that has since been followed in civilian life. The six years of war indeed provided the incentive to advance the whole process with an unprecedented speed and efficiency. It was an inspiration to visit the Army Blood Supply Depot at Bristol, under the direction of Brigadier, now Sir Lionel, Whitby, where a trained staff of over 300 were receiving the blood collected from voluntary donors by mobile army medical teams. Here blood and plasma were prepared for transport and storage. From this Army Transfusion Service trained medical officers were sent abroad to organize the collection, preparation, and storage of blood in the field. Field Transfusion Units were formed, which worked in the forward area in conjunction with the Field Surgical Units, and the British and Commonwealth soldier and the armies of our allies were indeed well served. For example, in the Italian theatre of war, a brewery was taken over in Bari, and here, despite all sorts of problems—flies being not the least among them—a Base Unit was set up by Lieut.-Colonel Wolstenholme. Eighty per cent. of the donors were British, everyone being a volunteer and unpaid for his services, except

\* Professor Stammers, who was my fellow consultant in Italy, has pointed out to me since this address was delivered, that an embryo blood transfusion service had been started in Birmingham as early as 1924, thus antedating the incident recorded here by several years.

for one pint of beer as a form of resuscitation after the blood letting. A Dakota aeroplane was allotted to the Unit, and this came to be known as the Blood Wagon. It regularly transported by air anything up to 500 bottles of blood and plasma to the Eighth Army front daily when hostilities were active. No national was denied blood, and it is a proud thought that many a Yugoslav, Pole, or German prisoner of war, and many another, owes his life to blood manufactured in the bodies of the men of these islands.

### ANÆSTHESIA

Of the contribution of war to the development of the art and science of general anæsthesia (which was first used for the wounded in the American Civil War) I can say little, except that the greatest modern advance, the introduction of the relaxant curare, came about during the Second World War, though, as far as I am aware, it did not have much application to the treatment of war injuries. I think the main effect of the Second World War in this context was in the better recognition of the status of anæsthesia. An adviser in anæsthetics was appointed eventually to each Command abroad, with Brigadier Ashley Daly at the War Office as the chief, and a fine organization was created under his leadership. Specialist anæsthetists enjoyed the same field rank as surgeons, and, if seniority in the service indicated, took command of Field Surgical Units and other establishments.

### GROWTH OF SPECIALISM

Let us now look up to scan some of the larger branches which have grown, and are still growing, upwards and outwards, from this sturdy trunk of established surgical principle—this trunk whose roots are in antiquity, and which has through the ages been nurtured by the blood of those stricken in battle, and tended by famous surgical husbandmen, sometimes for better, sometimes for worse.

Each great war in turn gave an impetus to the growth of specialism, the tremendous technical advances in each branch of which were made possible by the solution of the fundamental problems of surgery.

### ABDOMINAL SURGERY

In the recent war the surgery of the abdomen benefited particularly by the establishing of the value and practice of continuous gastric suction coupled with continuous drip infusion, for which we are largely indebted to the surgeons of the Middle East campaign under their mentor, Sir Heneage Ogilvie. It is interesting to recall in this connection that Baron Larrey used the indwelling stomach tube 150 years previously to feed a soldier whose jaw had been shattered.

### THORACIC SURGERY

"Much of the experience of the older surgeons was gained in the service of Mars," writes Sir Gordon Gordon-Taylor, "and it is not otherwise with the story of the evolution of thoracic surgery."

Sir Clement Price Thomas and Sir Russell Brock, outstanding figures today in the world of thoracic surgery, are of the same opinion. Brock saw the dramatic development of thoracic surgery of the period between the two great wars as being largely due to the impetus received from the First World War, and the return to civil practice of the young surgeons who had seen the possibilities offered. The late George Gask, who did so much to further progress in this domain of surgery, attributed the great strides made in 1914-18 to the "stimulus to research furnished by the unprecedented number of wounded." And indeed it was during this period that there developed a real understanding of the complicated physiology of the chest. Until that time the deliberate opening of the pleural sac, apart from the enforced drainage of an abscess, was generally considered inadvisable for reasons connected with the physiology of respiration, unless an enormously complicated apparatus was available—such as the famous pressure chamber of Sauerbruch.

### CARDIAC AND VASCULAR SURGERY

Of the surgery of the heart, which has so great a romantic appeal to the lay public, it is even more true to say that experience gained from observations upon wounds laid bare the possibilities upon which today's almost incredible operations are based. The possibility of any surgical interference upon heart wounds by the enterprising surgeon was for long years placed out of court because of ignorance of the heart's purpose, and the attributing to it of a mystic function. Even to the great intellect of Ambroise Paré it was "the fountain of the enlightened spirits." It is extraordinary in retrospect to consider how very short is the span of time since even the concept of heart surgery was born. Wrote Reidinger in 1888: "The suggestion to suture a wound of the heart, though made in all seriousness, scarcely deserves mention," and in 1896 Stephen Paget said: "Heart suture has been vaguely proposed as a possible procedure, and has been done on animals, but I cannot find it has ever been attempted in practice."

In the 1914-18 war several instances of recovery after extraction of missiles from the heart, chiefly by French surgeons, are recorded. In 1925 Sir Henry Sessions Souttar, of the London Hospital, deliberately opened the heart of a young lady with valvular disease, an almost unparalleled example of surgical skill and courage. Today operations for the relief of threatened heart failure are commonplace in every large hospital, to the safe accomplishment of which so much is owed to modern anæsthesia.

It had, however, long been recognized that operations upon the fibrous covering of the heart were sometimes life-saving, and in this sphere also was Baron Larrey a pioneer, for he had successfully carried out a pericardotomy on seven occasions, with four survivals. This is what that great man wrote 150 years ago: "We venture to say that practitioners in general have, without any real grounds, taken too grave a view of the effects of wounds of the fibro-serous envelope (the pericardium), and are open to much the same reproach respecting certain wounds of the heart."

Problems associated with preservation of the limbs when the main blood-vessels are disordered owe almost everything to observations made upon the field of battle. It is on this account in particular that the name of John Hunter is known to every student of medicine. The present-day practice of the grafting of arteries by stored arterial grafts had its origins in Tuffier's metallic tubes of the First World War.

### PLASTIC SURGERY

Though plastic surgery, the substitution of new noses for old, is as ancient almost as are the records of civilization, and skin grafting was developed in its modern form by Thiersch in the middle of the nineteenth century, yet it was the First World War that stimulated the miracles of reconstruction that we see performed today. To Sir Harold Delf Gillies, that distinguished sportsman-artist-surgeon, one must pay a deep tribute for the work he did upon those disfigured soldiers at Sidcup during the first war. His services were available also in the Second World War, and in the interval plastic surgery claimed many brilliant devotees, whose efforts still further perfected the reconstructive art.

Experience of the Second World War, particularly in the treatment of burns, has provided a rich heritage for us in civilian life. Every teaching hospital now prides itself in possessing its own plastic surgeon, and special centres created under the urgent stress of war have come to stay.

### NEUROSURGERY

As with the other specialities, to neurosurgery also was imparted an uplifting impulse, particularly during the Second World War, though it is of interest to record that advantage was taken of the opportunities offered by the Franco-Prussian War of 1870 to make studies in cerebral localization. I should like here to pay tribute to the outstanding contribution to this speciality made by our war-time colleague, the late Brigadier Sir Hugh Cairns, who was taken from us in the plenitude of his powers. Not only did he inspire many young war-time surgeons, who are now well established in this speciality, to take up neurosurgery, but he exercised a great influence on all subjects appertaining to head injuries, including the design of the modern crash helmet as worn by despatch riders on motor-cycles, and now a popular head-dress with the civilian motor-cyclist and his lady pillion companion.

Other ways in which we have reaped some reward will occur to many of my audience tonight, for it has been possible only to touch lightly on what appears to me to be some of the major contributions war has made. I should have liked amongst other things to have talked a little of rehabilitation of the sick and wounded as organized by the R.A.M.C. ; of physical medicine ; of pre- and post-operative care ; all of which received so great a stimulus as a result of the exigencies of war. I may not close, however, without mention of the debt all surgeons owe, and owe every day of their lives, to their sister profession of Nursing, which was born in its modern form out of the horrors of the Crimean battlefield.

I earnestly trust that what I have said today will not be interpreted in any sense that I think warfare is to be condoned. But we must glean what we may from adversity, so that man may benefit to some extent even from his own folly. In this we but obey the war-time injunction of Sir Winston Churchill: "We shall draw from the heart of suffering the means of inspiration and survival."

#### REFERENCES

In the preparation of this address I have freely consulted the following publications and reports, though the list is not complete: *Histories of Medicine*, by F. H. Garrison, Charles Singer, J. J. Walsh and Douglas Guthrie. *Biographies of Lord Lister*, by H. C. Cameron, Douglas Guthrie and Rhoda Truax. *Œuvres d'Ambroise Paré* (Malgaigne's edition). *Greek Medicine in Rome and Historical Relations of Medicine and Surgery*, by T. Clifford Allbutt. *Arabian Medicine*, by E. G. Browne. *Aequanimitas with other Addresses*, by William Osler. *International Clinics*, Vol. III: *British Journal of Surgery War Supplements on Head Injuries; Wounds of the Extremities; Abdomino-thoracic Wounds; Penicillin in Warfare*. *Official History of the War (1914-18): Medical Services. History of the Second World War: Medicine and Pathology. Journal of the Royal Army Medical Corps*, Vols. XIV, XXII. *Doctors by Themselves*, by Edward Griffith. *Bradshaw Lecture on the Surgery of the Heart*, by C. A. Ballance, 1920. Makins, G. H., *Brit. med. J.*, 1913, Vol. II. Ogilvie, in C.M.F. *Lancet*, 1945, Vol. I. *Proceedings of the Rome Surgical Congress*, 1945. Notes and Reports, etc., of Surgery in Italy.

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#### Correction

IN the obituary of the late Lieut.-Colonel J. D. Cruickshank, which appeared in our April issue, it was stated incorrectly, on the basis of press reports, that he was drowned "while trying out an underwater breathing apparatus." We are now informed by his widow that "his death was due, so far as we can tell, to drowning following a coronary thrombosis." We regret having given further publicity to this false report.

## MYOTONIA

BY

J. R. SEALE, M.R.C.P.

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MYOTONIA is a rare abnormality of muscular function in which a prolonged after-contraction of the affected muscles persists after voluntary effort has ceased. The most frequent subjective phenomenon is difficulty in relaxing the grasp. Objectively myotonia can often be demonstrated as a protracted localized muscular contraction which follows percussion of an affected muscle. Electro-myograms show high frequency discharges on mechanical stimulation and, following voluntary contraction, an after-discharge.

The following four cases which were seen recently in military hospitals illustrate some varieties of myotonia, the first three being discovered in the early stages of the illness because of the nature of their military duties.

### Case 1.

A soldier, aged 19, was admitted to hospital in November, 1954, for investigation of difficulty in relaxing the grasp of his hands. He had no disability until the age of 14, when he noticed he was clumsy with his left hand while writing (he was left-handed). Difficulty in letting go after grasping an object with this hand followed, and two years later his right hand was similarly affected. Over the years this symptom, which was aggravated by cold, gradually worsened. Six months prior to admission he began to have difficulty in lifting heavy objects because of weakness of his arms. He had been in the army for 14 months and from the first had difficulties. During his basic training his rifle drill was bad, because he could not "flick" the rifle off the ground with his right wrist in the first movement of the "slope arms" and could not let go the rifle in the third movement. Later he found it virtually impossible to manipulate the bolt of his Sten gun. He had no difficulty with the use of his legs and no other symptoms.

His mother had some difficulty with her hands, but he was not precise about the nature of this and he knew of no one else in the family with similar troubles.

On examination there was slurring of the speech and when he spoke quickly his words became indistinct. Marked myotonia was present in both hands and forearms. He had great difficulty in letting go his grasp and the action was grossly prolonged. All the muscles of the forearm went into spasm during the attempt to relax and this was worse when the grip had been intense. Mechanical stimulation with a percussion hammer of the tongue, biceps, triceps and thenar eminences produced a marked, prolonged local contraction of the muscle. There was weakness of the muscles of the upper limb but no definite wasting. Reflexes of the upper limb were all absent, but were present in the lower limb. There was no sensory abnormality, cataract, frontal baldness or testicular atrophy.



The urine contained 25 mg. per cent. of creatine (normal adult male= nil) and 40 mg. per cent. of creatinine (within normal limits).

A diagnosis of myotonia congenita was made and he was discharged from the army.

### *Case 2.*

This patient, aged 23, a university graduate in psychology, was on a "potential leader" course in the army. When at school he had noticed that in cold weather he was unable to write, do up buttons, play the piano or play rugger because his hands went "stiff." He also got cramp ("stiff limbs") if he stayed swimming for more than a few minutes. In warm weather, except for slight weakness of his hands, he was quite normal and by learning to avoid the cold he suffered little inconvenience.

He entered the army in October, 1954, and had no difficulty till he started weapon training in cold weather. He was slow in reloading his rifle, constantly reprimanded for lack of "snap" in arms drill, and finally he was told by the instructor to report to his medical officer because of great clumsiness in stripping a Bren gun.

There was no definite family history of myotonia, but his father gave up swimming in his youth because he got "cramp" after a few minutes in the water.

On examination, when warm, there was only a little slowness in fully extending his fingers after clenching his fist, but after half an hour in cold air out of doors this became more marked. After immersing his hands and forearms for five minutes in cold water the movement was grossly abnormal, taking him about five seconds to open his fist at all and it being impossible to extend his fingers fully even after several minutes. While trying to extend the fingers the flexor muscles of the forearm could be felt powerfully contracted. Several hours elapsed before the movements of the hand returned to normal, even though he was in a warm room. Reflexes, sensation and co-ordination were all normal, but there was some diminution of power of all muscle groups of both upper and lower limbs, although the muscles appeared of good size.

The report on the myogram was : "Electromyograms of the extensors of both forearms showed high frequency discharges on mechanical stimulation. On volition the motor unit potentials were within normal limits and following contraction there was an after-discharge. These findings are typical of myotonia."

A diagnosis of myotonia congenita was made and he was discharged from the army.

### *Case 3.*

This soldier, aged 18, reported sick in February, 1955, shortly after joining the army, because his hands became blue and cold easily in the winter. On further questioning he said that as long as he could remember his limbs had been weak, particularly his upper limbs and hands, and for this reason he had been excused P.T. and games at school. He had also found that in his trade as a butcher he had to get assistance with the carrying of large pieces of meat, but

there had been no recent increase in this weakness. In the two years prior to his joining the army he had occasionally found that he had difficulty in letting go the butcher's knife with which he cut the meat and sometimes in letting go his knife and fork during a meal.

He was the youngest of a family of five children, two brothers aged 27 and 25 and a sister aged 22 having no similar disability, but his third brother aged 20 had the same symptoms but to a greater degree (Case 4). His mother, aged 48, said she had always had weak hands (confirmed on examination), and her sister also had a similar weakness.

On examination his face was thin and expressionless, suggestive of myopathy. The cranial nerves were normal, no demonstrable weakness of the facial muscles being present. There was acrocyanosis of the hands. There was weakness of all the muscle groups of the upper and lower limbs most marked in the muscles of the hands and forearms. The weak muscles appeared of normal size except for the deltoid and latissimus dorsi, which were both abnormally bulky, and the right supraspinatus, which was wasted. The limb reflexes were present and equal. Delay in fully extending the fingers after relaxing the grip was present, but was not definitely abnormal, and cooling of the forearms by immersing in cold water did not increase this delay. Mechanical stimulation of the muscles of the limbs by percussion produced local contraction of normal duration. No abnormality was discovered in the central nervous system and the other systems appeared normal.

The report on the myogram was: "Intensity duration curves of the extensors of the right forearm, right deltoid and right supraspinatus are within normal limits. Electromyograms show no spontaneous activity with a full interference pattern of motor unit potentials on volition. The majority of the motor unit potentials in the right supraspinatus are of short duration and polyphasic. Conclusion: these findings are compatible with a myopathic lesion. No myotonic reaction was obtained."

A diagnosis of pseudo-hypertrophic muscular dystrophy was made and he was discharged from the army.

#### *Case 4.*

This patient, aged 20, was the brother of the previous case. He had not been accepted as fit for military service and was visited in his own home. Unfortunately, it was not possible to make a very thorough clinical examination and he was not prepared to go to London for an electromyogram.

He had noticed weakness of his limbs, upper more than lower, for many years. It had become more marked in the previous two years and he had had to take a light job helping on a chicken farm. Since he was aged 10 he had noticed difficulty in relaxing his grasp, particularly when carrying a bucket in cold weather; he could only gradually extend his fingers, but if he closed and relaxed his grip repeatedly the stiffness would soon go. When in bed he frequently had cramps in the muscles of his shoulders and calves.

On examination the power was markedly decreased in all muscle groups of

both limbs. The muscles appeared very well developed for a man of his size and the muscles of the right forearm were particularly bulky. There was slight slowness in fully extending his fingers which was not aggravated by cooling.

Mechanical stimulation of muscle gave a normal contraction. Limb reflexes and sensation were normal, as were the cranial nerves. The other systems were not adequately examined.

Before the results of the electromyogram of his brother were obtained, the diagnosis was considered to be either pseudo-hypertrophic muscular dystrophy or dystrophia myotonica. A final diagnosis of the former was made.

## DISCUSSION

Myotonia congenita (Thomsen's disease) and dystrophia myotonica are usually considered separate diseases. The main differential points in a typical case are as follows :

		<i>Dystrophia myotonica</i>	<i>Myotonia congenita</i>
Age of onset	...	After 15 years.	Starts early in life.
Myotonia	...	Localized to few muscles.	Widely distributed.
Muscles	...	Marked wasting of certain muscles.	Hypertrophied.
Limb reflexes	...	Absent.	Present.
Course	...	Progressive deterioration.	Usually non-progressive or improves.
Cataract	...	Present.	Absent.
Frontal baldness	...	Present.	Absent.
Testicular atrophy	...	Present.	Absent.
Family distribution	...	Only some members affected.	All members affected.
Mentality	...	Abnormal.	Normal.

It has been maintained that the diseases are essentially different by Batten & Gibb (1909), Siirala (1949), Thomasen (1948) and Bell (1947). If all cases were typical as described above there would be no controversy, but a large number of cases do not fit satisfactorily into either category, having certain features of both diseases. For this reason the diseases have been considered essentially the same by Rossett (1922) and Maas & Paterson (1939, 1950). Maas & Paterson point out that not only do many cases have "atypical" features, but that cases originally diagnosed as myotonia congenita later in life develop unmistakable features of dystrophia myotonica, and that in families of myotonia congenita some of the relatives have dystrophia myotonica and *vice versa*. Their conclusion is that all these cases should be included under the one name of Thomsen's disease.

Case 1 had marked features of myotonia which could easily be elicited clinically. Many of the features of "typical" myotonia congenita were present, but the muscular weakness and absent reflexes of the upper limb are atypical and the presence of creatine in the urine was suggestive of muscular wasting. It is this sort of case which Maas & Paterson suggest, if followed for years, will later develop other features of dystrophia myotonica.

Case 2 exhibited clinical myotonia only when cold. Thomsen (1876), who suffered from myotonia congenita himself, noticed that he was worse in cold weather, but for the condition to be only present when the patient is cold is rare. It was first described by Eulenburg (1886), who considered it a separate disease

and called it paramyotonia. He said that chilling causes a spontaneous tonic contraction of the muscles followed by a condition similar to paresis, and this accurately describes the condition that was present in this case. Rossett (1922) stated that in cases of paramyotonia the reaction described by Erb (1886) of prolonged local contraction of muscle on electrical and mechanical stimulation was not present, and this was so clinically in this case. Most cases of myotonia are worse in the cold (see Case 1), and it is now generally agreed that paramyotonia is only a slight variant of myotonia congenita. It is interesting to note that in this case the characteristic features of myotonia were observed in the electromyogram even though the patient was warm, when myotonia could not be demonstrated clinically.

Cases 3 and 4 are of a different category to the other two. Their histories were very suggestive of myotonia, but this was never demonstrated satisfactorily by clinical tests and the diagnosis of pseudo-hypertrophic muscular dystrophy was considered on clinical grounds alone. The electromyogram confirmed the presence of muscular dystrophy and evidence of myotonia was not forthcoming. Cases of muscular dystrophy do at times show symptoms suggestive of myotonia, and it was these symptoms that caused the difficulty in diagnosis.

### SUMMARY

Two cases of Thomsen's disease and two cases of pseudo-hypertrophic muscular dystrophy with myotonic symptoms are described.

The relationship of myotonia congenita, dystrophia myotonica and paramyotonia are briefly discussed.

I wish to thank Dr. A. T. Richardson of the Royal Free Hospital for the electromyograms and Lieut.-Colonel J. M. Milne, R.A.M.C., for the clinical notes on Case 1.

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# PAPER ELECTROPHORESIS OF SERUM PROTEINS

AN ANALYSIS OF SERA FROM 79 NORMAL HEALTHY INDIVIDUALS

BY

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THE electrophoretic separation of serum and other proteins on filter paper provides a simple and rapid method of protein fractionation. The technique was elaborated independently by several workers and was described by Wieland & Fischer (1948), Durrum (1950), Cremer & Tiselius (1950), Turba & Enenkel (1950) and Kunkel & Tiselius (1951).

In the British literature Flynn & de Mayo (1951) and Griffiths (1952) (1953) describe methods of paper electrophoresis which have since become popular in this country. The results to be described are those of the analysis of 79 sera from normal healthy individuals, using a method which in principle and in several details is similar to that used in many laboratories in Great Britain.

## MATERIALS AND METHODS

*Specimens.* Freshly separated serum was obtained from blood samples donated by the hospital staff of Queen Alexandra's Military Hospital, Millbank, and from blood donors of the South London Regional Blood Transfusion Service, the samples from the latter being serum in excess of that required for Kahn testing.

*Total protein estimation.* In all cases this was estimated by the method described by Kingsley (1942). The method was frequently checked by micro-Kjeldahl analysis.

*Rectifier.* The power unit supplied by Messrs. Evans Electroselenium Ltd. was used. Any similar full wave rectifier may be used or a simple circuit using 120 volt dry batteries in series with a milliammeter and the paper strips.

*Electrophoretic tank.* E.E.L. tanks were used.

*Paper.* Whatman No. 1. 34 × 5 cm.

*Buffer solution.*

Sodium barbital	...	...	...	30 g.
Sodium acetate (Hydrated)	...	...	...	19.5 g.
Hydrochloric acid N/10	...	...	...	205 ml.
Distilled water to	...	...	...	3 l.

**Dye.** 1 per cent. Bromophenol blue in 95 per cent. ethyl alcohol saturated with mercuric chloride. Dioxan, ether and liquid paraffin were used in washing and clarifying.

**Technique.** The compartments of the tank are filled with buffer. A pencil line is drawn across the filter paper strip 13 cm. from the end. The strip is soaked in buffer solution, placed in the bath and drawn taut. Excess buffer at the pencil line is removed with filter paper. 0.1 ml. of fresh serum is applied evenly along the pencil line from a 0.2 ml. graduated pipette, raising the pipette before reaching the edge of the paper. Even application is essential and requires practice. Equally satisfactory results may be obtained by laying a strip of filter paper 1 cm. wide, previously soaked in the serum, along the pencil line and leaving for four minutes. The tanks are then closed and a current adjusted to 2 m.amps per strip is passed for sixteen hours. The strips are then removed and dried, hung in a hot air oven at 100° C. for fifteen minutes. They are placed in the dye for five minutes and washed in tap water until the background is white, then soaked in dioxan for one minute, then ether for one minute. The strip is then cut to fit the scanner frame and immersed in liquid paraffin at 100° C. for ten minutes before mounting between glass slides.

**Scanning.** The E.E.L. scanner was employed, a Chance green glass filter being used. The curves obtained were completed by hand to the base line. The graph was transferred to squared paper and the areas beneath the curves calculated by counting squares. The proportions and absolute values of the various protein fractions were then calculated.

## RESULTS

The results obtained are seen in Table 1.

Table 1.  
All figures in g./100 ml.

No.	Total Protein	Albumin	$\alpha_1$ Globulin	$\alpha_2$ Globulin	$\beta$ Globulin	$\gamma$ Globulin
1	7.10	4.95	0.00	0.35	0.80	1.00
2	7.50	4.60	0.00	0.50	0.70	1.70
3	7.00	4.50	0.00	0.40	1.00	1.10
4	6.60	3.90	0.20	0.70	0.70	1.10
5	7.10	4.30	0.00	0.40	1.00	1.40
6	7.60	4.40	0.20	0.70	0.90	1.40
7	7.30	4.80	0.20	0.80	0.80	0.70
8	7.10	4.60	0.00	0.70	1.00	0.80
9	7.39	4.57	0.13	0.87	0.71	1.21
10	6.49	4.26	0.12	0.39	0.72	1.00
11	6.90	5.30	0.08	0.08	0.70	0.74
12	7.32	5.02	0.20	0.20	0.80	1.10
13	7.40	4.70	0.20	0.80	1.00	0.70
14	6.80	4.30	0.00	0.90	0.90	0.70
15	6.85	4.42	0.25	0.47	0.57	1.14
16	7.57	5.02	0.20	0.80	0.85	0.70
17	7.42	5.34	0.00	0.38	0.70	1.00
18	7.20	4.60	0.00	0.60	1.00	1.00

Table 1.—*cont.*

No.	Total Protein	Albumin	$\alpha_1$ Globulin	$\alpha_2$ Globulin	$\beta$ Globulin	$\gamma$ Globulin
19	6.90	4.70	0.00	0.40	0.70	1.10
20	7.10	4.70	0.30	0.70	0.60	0.80
21	7.00	5.20	0.20	0.20	0.70	0.70
22	6.80	3.80	0.10	0.50	1.00	1.40
23	6.70	4.10	0.00	0.80	1.00	0.80
24	7.20	4.30	0.20	0.50	1.00	1.20
25	7.20	4.20	0.00	0.90	0.80	1.30
26	7.30	4.10	0.20	0.30	1.00	1.70
27	6.30	4.60	0.00	0.80	0.80	1.10
28	6.80	4.90	0.10	0.30	0.90	0.60
29	6.50	5.10	0.00	0.10	0.30	1.00
30	7.30	4.60	0.30	0.60	0.70	1.10
31	7.20	4.50	0.00	0.50	0.90	1.30
32	7.00	4.80	0.00	0.30	0.60	1.30
33	7.00	4.70	0.10	0.70	0.90	0.60
34	6.80	4.20	0.00	0.60	0.70	1.30
35	7.40	4.80	0.00	0.70	0.60	1.30
36	6.70	4.50	0.00	0.50	0.50	1.20
37	6.70	4.80	0.00	0.40	0.70	0.80
38	7.30	5.30	0.00	0.50	0.80	0.70
39	6.70	3.90	0.20	0.50	0.80	1.30
40	7.60	5.00	0.40	0.80	0.80	0.60
41	6.70	4.40	0.10	0.60	0.70	0.90
42	6.80	4.40	0.30	0.50	0.70	0.90
43	7.30	4.60	0.10	0.50	0.60	1.50
44	7.50	4.40	0.30	0.80	0.50	1.50
45	6.50	4.10	0.20	0.60	1.00	0.60
46	7.70	5.70	0.00	0.40	0.80	0.80
47	7.20	4.70	0.00	0.60	0.90	1.00
48	7.30	4.60	0.00	0.60	0.80	1.30
49	7.00	4.50	0.00	0.60	0.80	1.10
50	6.90	4.50	0.00	0.50	0.60	1.30
51	6.80	4.00	0.20	0.50	0.90	1.20
52	6.40	4.80	0.00	0.30	0.50	0.80
53	6.70	4.60	0.10	0.40	0.70	0.90
54	6.80	4.50	0.20	0.60	0.50	1.00
55	7.40	4.80	0.30	0.80	0.70	0.80
56	7.10	5.00	0.00	0.40	0.40	1.30
57	7.10	4.70	0.20	0.60	0.70	0.90
58	7.40	5.30	0.20	0.70	0.70	0.50
59	7.30	4.30	0.20	0.90	0.80	1.10
60	7.00	4.80	0.10	0.30	0.70	1.10
61	7.30	4.70	0.00	0.40	0.80	1.40
62	7.10	4.50	0.20	0.50	0.60	1.30
63	7.50	4.40	0.20	0.50	0.90	1.50
64	7.10	4.70	0.30	0.50	0.70	0.90
65	7.50	4.70	0.20	0.50	0.70	1.40
66	7.80	5.30	0.10	0.70	0.70	1.00
67	6.50	4.30	0.00	0.50	0.60	1.10
68	7.00	5.60	0.00	0.50	0.50	0.40
69	7.50	4.30	0.40	0.60	0.70	1.50
70	6.90	4.40	0.00	0.50	0.80	1.20
71	7.40	4.10	0.20	0.60	1.20	1.30
72	7.10	4.80	0.00	0.50	0.70	1.10
73	6.60	4.30	0.00	0.60	0.60	1.10
74	6.50	4.40	0.20	0.40	0.70	0.80
75	6.70	4.40	0.20	0.50	0.80	0.80
76	7.50	5.60	0.00	0.50	0.50	0.90
77	7.00	5.10	0.00	0.30	0.50	1.10
78	6.90	4.90	0.20	0.40	0.60	0.80
79	7.10	4.50	0.30	0.70	0.80	0.80



## DISCUSSION

The results of paper electrophoresis of serum and plasma proteins have been compared with the Tiselius method of electrophoresis by Koiw, Wallenius & Grönvall (1952), Levin & Oberholzer (1953), and MacKay, Volwiller & Goldsworthy (1954), and with chemical analysis by salt fractionation by Levin & Oberholzer (1953) and Oosterhuis (1954). It is generally agreed that the precision of paper electrophoresis as evidenced by the reproducibility of results with human serum or plasma does not equal that of the classical Tiselius method. The variations that have been introduced in the methods of paper electrophoresis have to some extent been prompted by the desire to bring results into closer agreement with those of Tiselius electrophoresis. To this end certain factors have been proposed by which the globulin fractions obtained by paper electrophoresis may be multiplied. It is questionable whether this correction is desirable. More is to be gained by the consideration of the results of paper electrophoresis independently and the establishment of "normal" values of protein fractions obtained by electrophoresis under standard conditions. Griffiths (1953) (1952), having tested a large number of dyes, favoured bromphenol blue for the staining of the protein fractions and introduced the use of a photo-electric scanner for rapid and sufficiently accurate measurements of the protein fractions. He found no evidence warranting the use of globulin fraction factors.

Grassmann & Hannig (1952), MacKay *et al.* (1954) and Sommerfelt (1952) have made multiple determinations either on the same or different sera and record the reproducibility obtained. Our own results are recorded in Table 1. Table 2 gives the range, arithmetical mean, standard deviation and coefficient of variation for each protein fraction.

Table 2.  
All figures in g./100 ml.

		Total Protein	Albumin	$\alpha_1$ Globulin	$\alpha_2$ Globulin	$\beta$ Globulin	$\gamma$ Globulin
Range	Lowest ...	6.30	3.80	0.00	0.10	0.30	0.50
	Highest ...	7.80	5.60	0.40	0.90	1.20	1.70
Arithmetical mean ...		7.07	4.63	0.11	0.54	0.75	1.04
Standard deviation ...		0.339	0.395	0.115	0.182	0.168	0.283
Coefficient of variation		4.78%	8.52%	105%	33.6%	22.4%	27.2%

Table 3.  
All figures in g./100 ml.

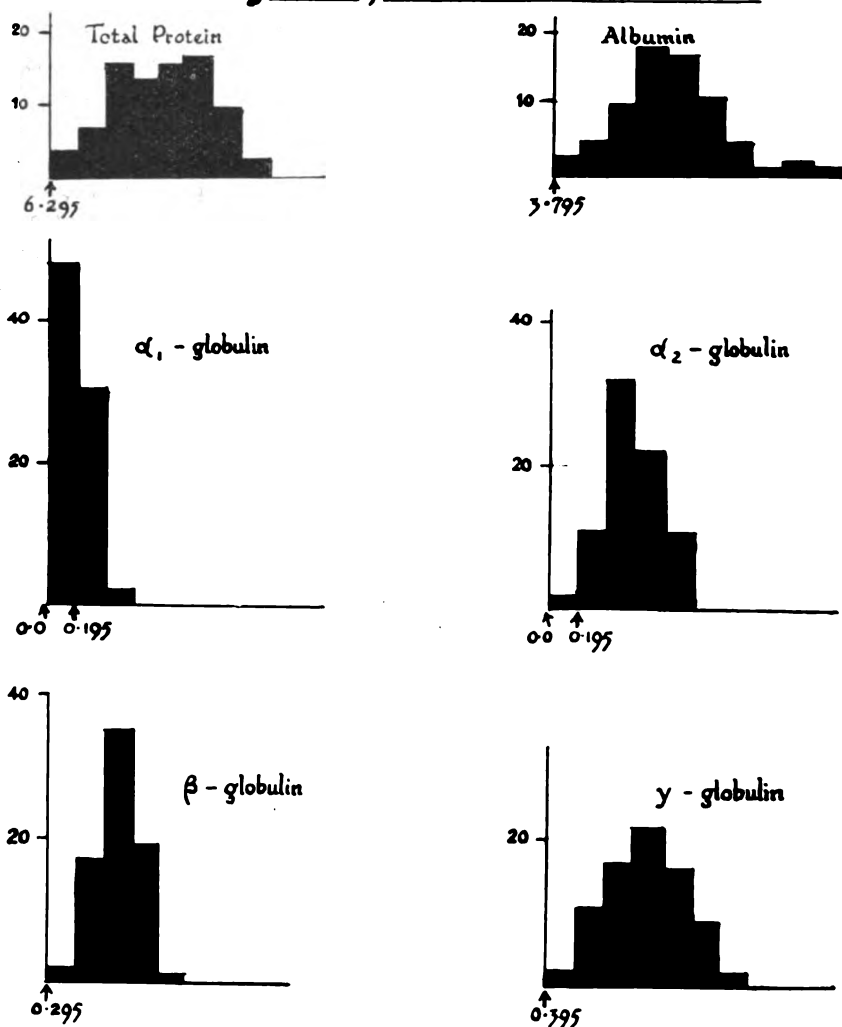
	Total Protein	Albumin	$\alpha_1$ Globulin	$\alpha_2$ Globulin	$\beta$ Globulin	$\gamma$ Globulin
20%	6.64-7.50	4.13-5.13		0.31-0.77	0.54-0.96	0.68-1.40
2%	6.28-7.86	3.71-5.55	0.0-0.30*	0.12-0.96	0.36-1.14	0.38-1.70

\* Because of skew distribution a valid confidence limit cannot be calculated. See text.

Our figures confirm the previously observed wide range of the smaller globulin fractions.

Fig. 1 shows histograms of the protein values. With the exception of the figures for  $\alpha_1$  globulin the histograms show a modal distribution enabling the establishment of confidence limits which are shown in Table 3. We have chosen

### Histograms of Protein Fraction Values.



**Vertical scale :** Number of Values.

**Horizontal scale :** Protein value in units of 0.2 G./100 ml.

FIG. 1

confidence limits expressing the likelihood of 20 per cent. and 2 per cent. of a similar population being outside those limits. The limits have been calculated assuming no prior knowledge of whether the abnormal readings will be higher or lower than normal. It is suggested that a result falling outside the 20 per cent. limit should be considered suspicious, while a result outside the 2 per cent. limits should be considered almost certainly abnormal.

The histogram of the  $\alpha_1$  globulin values shows a skew distribution, this being due to the large number of values in which the  $\alpha_1$  fraction was too small to be detected. Whilst valid confidence limits for  $\alpha_1$  globulin cannot be calculated, the figures can still be used as a guide. As only two of the 79 readings are above 0.3 g., an upper limit of 0.3 g. could probably be used with as much confidence as the 2 per cent. limits.

### SUMMARY

1. The results of the analysis of sera from 79 normal healthy individuals are recorded.
2. The results are analysed and their significance discussed.
3. The literature is briefly reviewed.

We are indebted to the hospital staff of the Queen Alexandra's Military Hospital and to the South London Regional Blood Transfusion Service for the donation of serum samples ; to Messrs. Evans Electroselenium Ltd. for loan of equipment ; to Mr. D. T. Beeston of the War Office, A.M.D. Stats., for advice ; and to Lieut.-Colonel P. D. Stewart, A.D.P. Eastern Command, for his help and encouragement.

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## A METHOD OF TREATING A FRACTURE-DISLOCATION OF THE ELBOW

BY

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A SERGEANT, aged 27 years, was involved in a motor-cycle accident, sustaining a simple comminuted fracture of the left olecranon process, with an anterior dislocation of the elbow-joint (Fig. 1, Plate 1).

Although the elbow and forearm were grossly swollen, the circulation in the limb was satisfactory. There was a marked ulna and radial nerve motor weakness and impairment of sensation over the areas of distribution of the median and radial nerves.

The elbow was manipulated and immobilized at a right angle flexion. However, the reduction of the dislocation was unstable and required remanipulation, when it was found that the reduction could only be maintained with the joint in full extension. This was unacceptable as it would inevitably lead to the joint becoming stiff in the extended position. This is a grave disability, for the patient is unable to approximate the hand to his face or upper trunk, thus eating, shaving, dressing, etc., have to be performed one-handed.

Therefore, four days after the accident, on the advice of Colonel Marsden, Consultant Orthopædic Surgeon, a Kirschner wire was inserted through the shaft of the ulna close to the fracture site, and a suitable stirrup applied. The elbow was positioned as in Fig. 2, Plate 1, and traction (10 lb.) applied in the axis of the shaft of the humerus. Radiography showed that the dislocation was reduced though with wide separation of the fragments of the olecranon process (Fig. 3, Plate 1). This fracture was ignored and active movements of the elbow commenced at once, which, with the elevation, allowed the swelling to subside rapidly. After three weeks the Kirschner wire was removed and at this stage the active range of movement was from 85° to 135°. The arm was placed in a collar and cuff and vigorous active movements encouraged.

Five weeks later the nerve lesions had recovered completely. Six months after injury active flexion was possible to 45°, and though there was no active extension, the joint would passively extend to 130° (Fig. 4, Plate 1).

Thus with his arm at his side the patient would flex the elbow, and on relaxing, the weight of the forearm would passively extend the joint, but if the arm was held above the horizontal it was impossible to straighten the elbow actively.

### DISCUSSION

Stable reduction of a fracture-dislocation of the elbow could only be obtained in extension and this was not acceptable. Operative interference was avoided, as

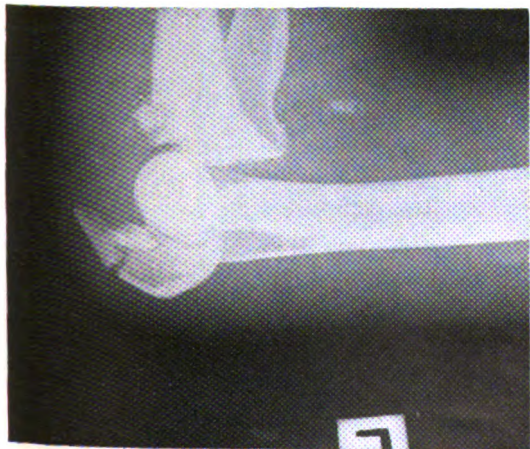


FIG. 1



FIG. 2



FIG. 3



FIG. 4

PLATE I



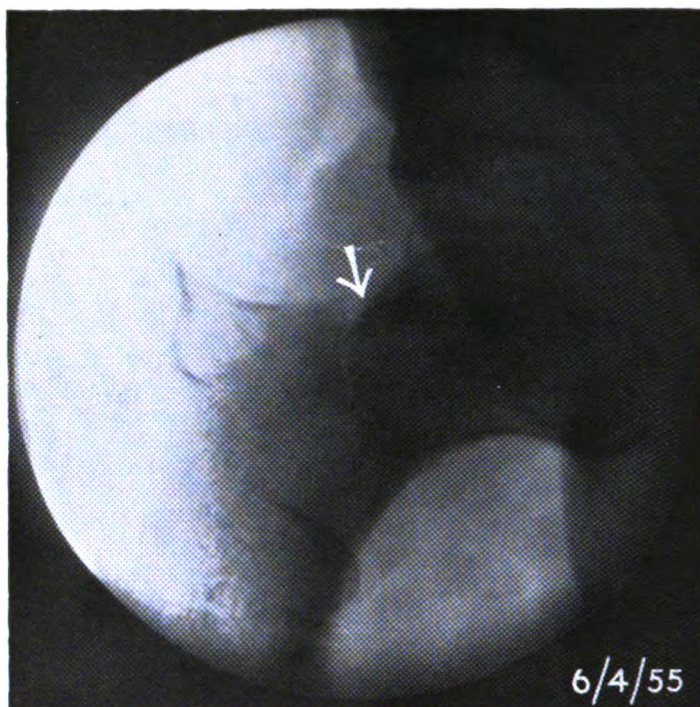


FIG. 1

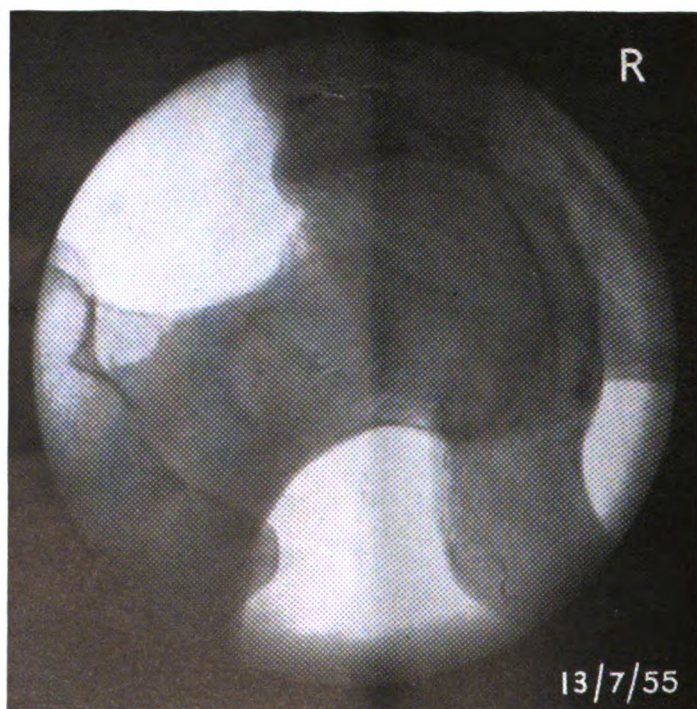


FIG. 2  
PLATE I

it was felt that, apart from the technical difficulties, it would have left a stiff elbow-joint.

With continuous skeletal traction, however, reduction could be maintained in flexion, which also allowed active movements to be instituted at once.

The end result was a stable elbow-joint with a very useful range of movement which, in spite of the radiographic appearances of the fibrous union of the comminuted fracture of the elecranon, gave a functional value of category P.2 U.3. L.E.

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## **MARCH FRACTURE OF THE NECK OF THE FEMUR**

### **A REPORT OF ONE CASE**

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"MARCH," "Fatigue," or "Stress" fracture may occur in many sites, but it is most frequently encountered in the shafts of the metatarsals. It has been reported in the femur several times (Watson Jones, 1955 ; Gibbens, 1945) in the past, but we feel the present case merits a short note in order to emphasize the difficulty which may arise in making the diagnosis, and to put on record one more instance of what, indeed, is not a very common condition.

### **CASE HISTORY**

Private J. R. B., aged 19, had had six months' service in his corps, and was accustomed to heavy labouring work. On 7th March, 1955, he was helping to push a hand truck loaded with ammunition when his right foot slipped and he just managed to stop himself from falling flat on his face by bringing his right knee up sharply. He had no pain at the time, carried on working for an hour, and marched back to his quarters (a distance of half a mile) when the work was finished. When he got back he sat down to rest for five minutes, and then on trying to get up again had a sudden severe pain in the right groin, although he



had made no violent movement in rising. He was just able to stand in spite of the pain, and made his way thirty yards to the Medical Centre by leaning on the arm of a comrade to take the weight off the leg.

He was sent to a M.R.S. where he was put to bed for two days ; and then, feeling better, was given special leave to go to a wedding in London, but as he was walking from the bus to the station his right leg "suddenly gave way" under him. He nearly fell, and at the same time he had the same sudden severe pain in the right groin as before. He went back to the M.R.S., and spent the next ten days in bed. When he got up again on 20th March the pain, though present, was less severe. On 27th March a radiograph was taken locally, but was reported to be normal. He was returned to his unit on 28th March still limping and having a little pain ; but as this got worse during his first day he was readmitted to the M.R.S. once more, and referred next day to this hospital.

On admission on 1st April, 1955, he was found to be a rather slow, good-natured, puzzled lad, who complained of pain and tenderness in the right groin, which was made worse by weight-bearing, was eased by sitting, and after a walk would usually take ten minutes to pass off. He had never had a serious illness in the past, and his family history was without interest.

Examination showed him to be well built and muscular ; he could not stand on his right leg without letting his pelvis sag to the left ; there was no swelling or deformity ; all active movements of the right hip were limited by pain, though passive movements could be gently carried through a full range ; there was limitation by painful spasm of straight-leg-raising on the right side. There was no shortening of the limb, and no wasting of the muscles. On palpation he was found to be tender in his right femoral triangle.

The rest of a full physical examination showed no other abnormality : radiography of the chest and blood count were normal.

In view of the tenderness in the right groin a provisional diagnosis of adductor muscle strain was made, and radiographs of pelvis and hip-joints requested. In the meantime he was put to bed.

To our surprise the radiograph revealed a fracture of the neck of the right femur (Fig. 1, Plate 1).

#### TREATMENT

On 10th April he was put in a Thomas splint with light skin traction ; this gave him immediate relief from pain. He was given intensive quadriceps exercises from the beginning. On 27th April he was put into a plaster spica, in which, after a further three weeks, a window was cut to allow observation of the quadriceps. On 13th June the spica was removed and he was allowed to begin non-weight-bearing exercises, and on 30th June he was allowed up for an increasing period each day. On 12th July he was walking very well without any pain, and on 27th July was discharged on sick leave. He has, since then, been attending the Convalescent Wing for games and exercises, and is now judged to have made a complete recovery. The healing of the fracture is shown in the radiograph (Fig. 2, Plate 1).

## SUMMARY

One case of spontaneous "Stress" fracture of the neck of the femur in an otherwise well-trained and perfectly fit young soldier is described.

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## REPORT ON A COMPARISON OF THE PAIN-PRODUCING EFFECTS OF TWO PREPARATIONS OF STABILIZED STREPTOMYCIN SULPHATE

BY

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## INTRODUCTION

A SMALL pilot trial was carried out to compare the relative pain-producing effects of two preparations of stabilized streptomycin sulphate.

This was undertaken because a clinical impression had been formed that the larger volume of the preparation used in this hospital caused more pain than other preparations of smaller bulk but of equal streptomycin content.

## MATERIALS

The preparations used were Streptaquine (Evans), containing one gram of streptomycin in 4 ml. ; and Strepolin (Glaxo), containing one gram of streptomycin sulphate in 2 ml.

## METHOD

For the purpose of the trial 20 patients, 10 male and 10 female, were selected at random from two wards. They were informed of the nature of the trial but were not told which preparation they were receiving. Because of the small numbers involved it was thought undesirable to give injections at random as patients might in this way have received undue amounts of one or other preparation. Instead, a prearranged scheme of injections was followed so that each patient received an equal number of 4 ml. and 2 ml. injections given in such an order that the patient could not be preconditioned to the effect of each injection by the order in which he had received the previous ones.

Accordingly, on succeeding days each were given either 4 or 2 ml. doses in the following order : 4 2 2 4 4 2 4 2 2 4 4 2 4 2 . Only the nurse giving the injections knew of the nature of the preparations, and only one nurse performed the

injections on each ward throughout the trial. All patients were bed patients and the injections were given daily while the patient was lying at rest in bed in the prone position. The injections were made into the upper outer quadrant of the buttock, using 21 s.w.g. needles.

The patients were asked not more than three hours and not less than one hour after injection whether or not any pain had resulted, and they were again questioned twenty-four hours later if any further pain had arisen. All those who complained of pain did so on the first questioning. No one complained of pain on the second questioning.

### RESULTS

These are shown in table form as follows :

	Injections 4 ml.				Injections 2 ml.			
	Patients		Injections		Patients		Injections	
	No.	per cent.	No.	per cent.	No.	per cent.	No.	per cent.
Painful	12	60	26	18.6	6	30	7	5
Pain free	8	40	114	81.4	14	70	133	95
Total ...	20	100	140	100	20	100	140	100

A statistically greater number of patients complained of pain with the 4 ml. injection than with the 2 ml. injection. More 4 ml. injections caused pain than 2 ml. injections. The difference was again statistically significant.

### CONCLUSION

This small trial shows that a stabilized solution of streptomycin sulphate has a pain-producing property, and although this is small it is shown that the 4 ml. injection is significantly more painful than the 2 ml. injection. This confirms the findings of Stradling & Kreuger (1954) and is contrary to what was found by Thomas & Perthyn Jones (1955).

### SUMMARY

A small pilot trial is described which shows that the intramuscular injection of a 4 ml. preparation of stabilized streptomycin sulphate is significantly more painful than the 2 ml. preparation.

### ACKNOWLEDGMENTS

Thanks are due to Captain F. W. O'Grady, R.A.M.C., for his help in the trial and to Lieut.-Colonel S. W. Large, R.A.M.C., for his encouragement.

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## Book Reviews

**MAN'S MASTERY OF MALARIA.** By Paul F. Russell, M.D., M.P.H. London : Oxford University Press. Pp. 308+xv. Illustrated. 25s.

To those who had the privilege of hearing Dr. Paul Russell deliver the Heath Clark Lectures at the London School of Hygiene and Tropical Medicine in 1953, this book, which is a permanent record of these lectures, will be more than welcome.

The author follows the development of man's knowledge of malaria from prehistoric times up to the present under the appropriate headings of ætiology, therapy and prophylaxis.

The book is very readable and is well and suitably illustrated. The twenty-six closely printed pages of references at the end give some indication of the painstaking work which has gone to the preparation of this book.

It can be thoroughly recommended to all interested in tropical medicine and medical history generally. W. M. McC.

**OPERATION RANGOON JAIL.** By Colonel K. P. Mackenzie (late R.A.M.C.). London : Christopher Johnson. 1954. Pp. 201. Illustrated. 15s.

This book, which should be read by all ranks of the Royal Army Medical Corps, gives a moving account of the horrors of captivity in a Japanese camp. As A.D.M.S. of a division the author was captured during the 1942 retreat from Burma, and endured physical and mental brutality which is almost unbelievable if the facts had not been subsequently repeatedly proved from other similar camps. With modesty and scrupulous fairness the author tells of his tireless efforts to ameliorate the plight of his fellow captives, including his surgical technique with the bare minimum of equipment and appalling absence of facilities for nursing.

This is a terrible story but it is right that it should not be forgotten. The author's epic was in the highest traditions of *In Arduis Fidelis*. A. M.

**THE DESIGN AND CONSTRUCTION OF REMOVABLE ORTHODONTIC APPLIANCES.** By C. Philip Adam, F.D.S., D.Orth. Bristol : John Wright and Sons, Ltd. 1955. Pp. 96. Illustrated. 17s. 6d.

This is an excellent book on the construction of removable orthodontic appliances and will be of considerable interest not only to the technician but to the practitioner as well.

No approach to treatment planning is attempted but sufficient information is given of the basic principles of tooth movement to make appliance design fully understandable. The diagrams are clear and the photography of a high standard enabling all instructions to be clearly followed.

It should have a wide appeal to anyone working in the field of orthodontics either in hospital or private practice. The price is modest which explains the only criticism of the book, namely the binding. K. H.

**TROPICAL MEDICINE FOR NURSES.** By A. R. D. Adams and B. G. Maegraith. First edition. Oxford: Blackwell Scientific Publications. 1955. Pp. 314+vii. Illustrated. 30s.

This book supplies a long-felt want for the Nursing Services. Good medical observation of the patient in the tropics is necessary to prevent catastrophies. The nurse sees more of the patient than the doctor. This edition, the first of its kind, gives an excellent, concise description of tropical conditions and is well illustrated. There is everything here from the ætiology of disease, to treatment, including prophylaxis.

W. D. H.

**A SHORT PRACTICE OF SURGERY.** By Hamilton Bailey, F.R.C.S.(Eng.), F.A.C.S., F.I.C.S., F.R.S.E. and R. J. McNeill Love, M.S.(Lond.), F.R.C.S.(Eng.), F.A.C.S., F.I.C.S. Tenth edition. London: H. K. Lewis & Co. Ltd. Pp. 1,125+viii. Illustrated. £4 4s.

It is said that one picture is better than a thousand words, and the tenth edition of this well-known book bears this out. In spite of its 1,100 pages, it is probably too brief for the postgraduate and surgical student, but it is an excellent text-book for the undergraduate.

The larger pages of this edition are a great improvement, yet it remains a not unwieldy book. It will continue to merit, and to an enhanced degree, the description "the student's friend".

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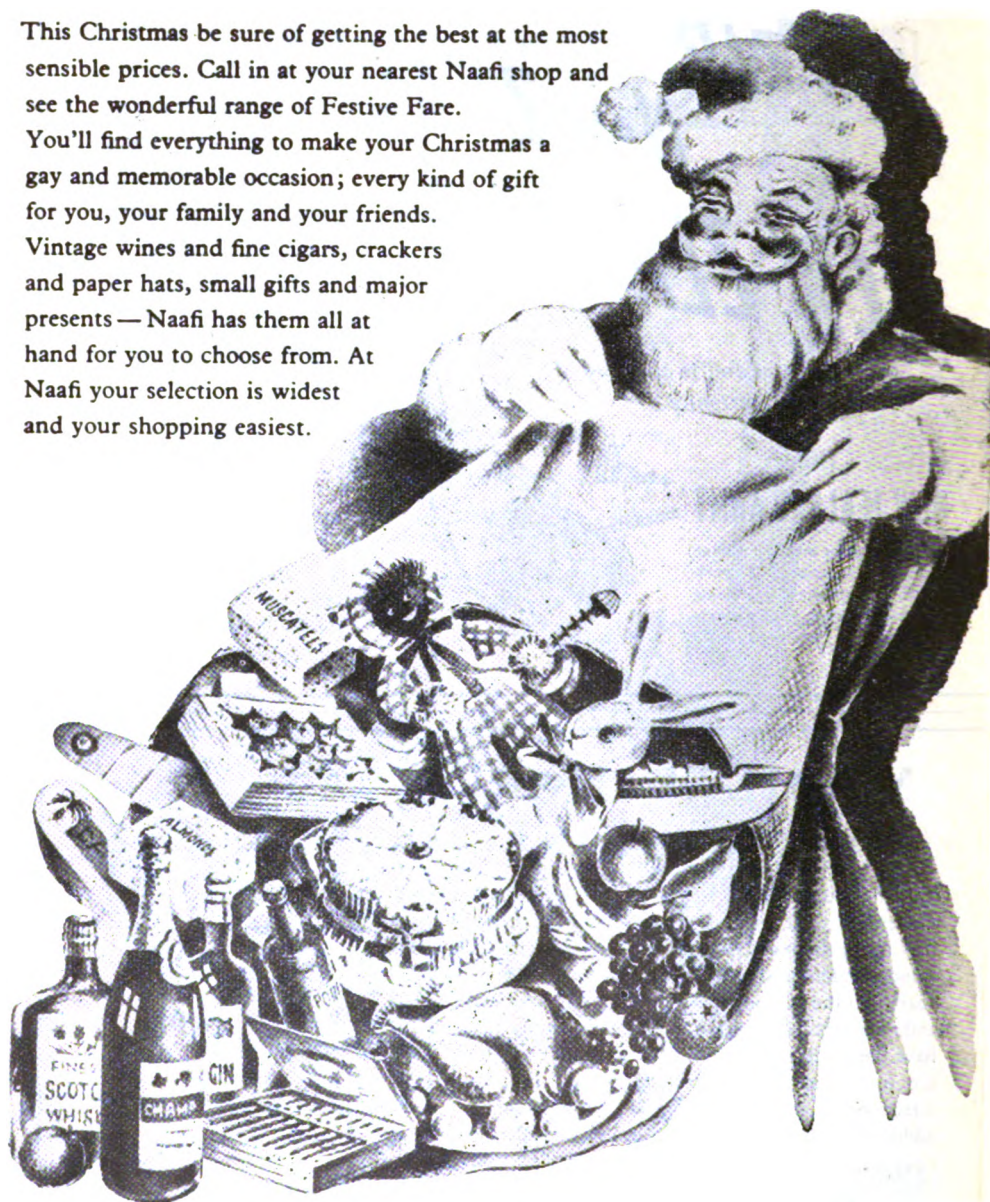
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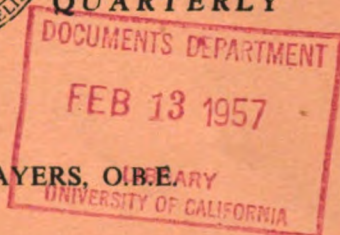
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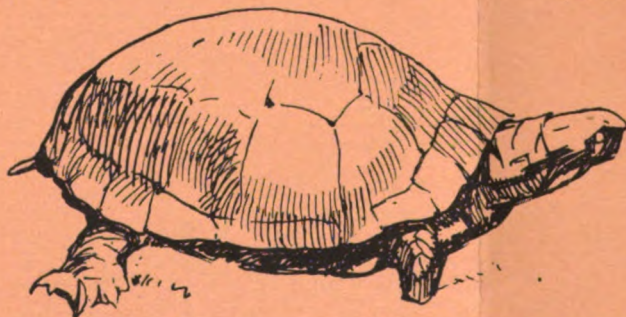
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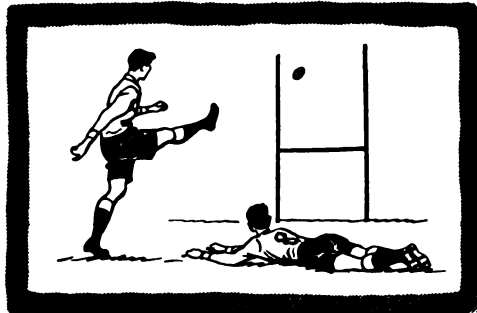
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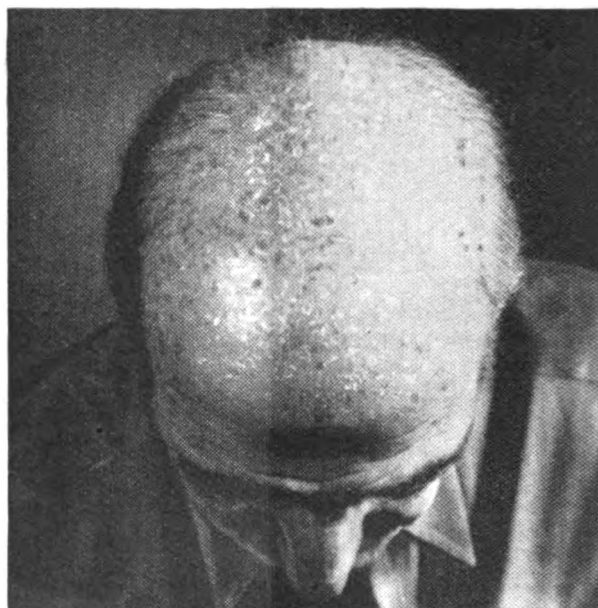
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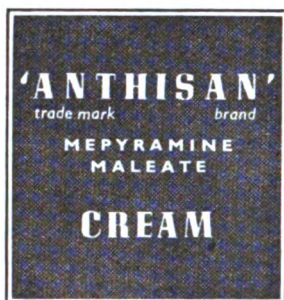
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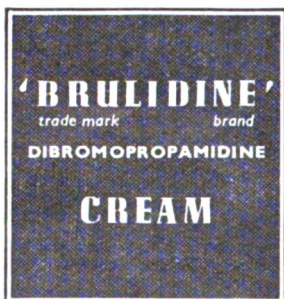
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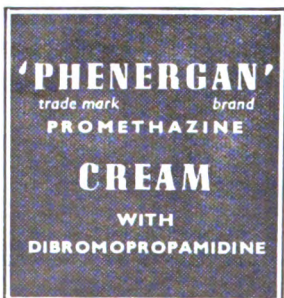
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## **THE RESUSCITATION OF BATTLE CASUALTIES**

BY

**Colonel A. J. CLYNE, C.B.E., B.Sc., M.B., F.R.C.S.**

*Formerly Consulting Surgeon, Far East Land Forces*

PROGRESS in surgery has been so rapid that it is difficult for the busy surgeon to keep up with it. The management of shock is an example and this paper reviews some of the recent developments in resuscitation and shock prevention. During the 1914-1918 war the pathology of traumatic shock was seriously studied for the first time and sound principles for its treatment were established. The inter-war years were relatively unproductive, despite some experimental work on both sides of the Atlantic, with sharp differences of opinion over the relative importance of the various factors involved in shock production—neurogenic, oligæmic and possibly toxæmic. There were few clinical studies of the condition during this time. The 1939-1945 war again brought shock to the forefront of surgical thought; existing knowledge was summarized and extensive clinical studies made from battle casualties. Meanwhile large-scale arrangements were made for the collection, storage, delivery and giving of blood wherever it was needed. The bombing of British cities brought the crush syndrome and again raised the question of a toxæmic factor in some types of post-traumatic shock.

By the end of the war there was general agreement on the factors which may produce, increase or modify surgical shock and the principles of treatment were well established, although practical difficulties had prevented them from being followed to their logical conclusions. This had to await the decade since the war when, with the vast amount of war-time experience collected, sifted and

assimilated, and with important technical advances, the opportunity for trials of improved resuscitation methods came with the localized wars in Korea and Indo-China. The results have been of much interest and are likely to have a profound influence on our ideas about the management of shocked casualties in future.

### AETIOLOGICAL FACTORS IN TRAUMATIC SHOCK

Surgical shock is not a single entity but a series of syndromes which, although sometimes seen in almost pure form, more commonly overlap and coalesce. There appear to be three well-defined factors concerned in the production of shock following trauma :

- (a) A neurogenic element resulting from excessive nerve stimulation.
- (b) An oligæmic element resulting from blood or plasma loss.
- (c) A toxæmic element resulting from muscle destruction.

Occasionally one factor predominates so as to produce a distinct type of shock, but the more usual picture is the result of their combination in varying proportions and recognition of this is important in management. Additional factors may complicate the overall picture such as dehydration, salt and electrolyte depletion, and bacterial wound infection. These troublesome and often dangerous complications can usually be prevented by appropriate early measures, if anticipated.

*The neurogenic factor* in shock results mainly from painful stimulation, although mental apprehension is not unimportant. It is seen in the pure form as the vasovagal syndrome, *i.e.* syncope after an injury, often slight, though occasionally it may be fatal by itself. Generally with battle casualties, this is the first stage of surgical shock and, although in minor wounds it is transitory, more serious cases with blood loss pass on to secondary shock with or without a period of recovery from the primary neurogenic phase. In its initial state neurogenic shock is not usually serious and responds rapidly to treatment. If it continues, however, or if it is associated with blood loss, it can be dangerous. The importance of neurogenic factors in wound shock has been stressed by Slome & O'Shaughnessy (1938), Wilson (1944), and others.

*The oligæmic factor* results from loss of circulating blood from hæmorrhage, or of serum, and is well known. It is important to realize that this loss need not be external and that extensive loss may occur into body cavities or tissue spaces, and Blalock (1934), from his experiments, concluded that all the manifestations of surgical shock could be accounted for on this basis alone.

*The toxæmic factor*, long suspected from strong clinical evidence in certain types of wound or injury, had to wait for biochemical confirmation by Green & Bielschowsky (1943) at Sheffield during the last war. Following intensive work stimulated by the crush syndrome in air raid victims, they finally isolated adenosine triphosphate, a product of muscle disintegration, which can be demonstrated in the blood after extensive muscle damage. The exact role of this and related

substances in the shock syndrome remains uncertain. There is some doubt whether it can produce serious shock by itself, although the rapidity of onset of profound shock following the return of circulation to a crushed or damaged limb is suggestive. However, there is little doubt that toxæmic factors can be a powerful aggravating influence on the shock syndrome where muscle damage is extensive (Green & Stoner, 1950). In addition to the above, surgical shock may be complicated and intensified by such factors as water and electrolyte loss. Although either of these states can produce a syndrome of its own with shock-like features (Marriott, 1950), their importance in battle casualty shock is as a complicating factor under certain circumstances, recognition of which is necessary. In hot weather or under tropical conditions, because of excessive sweating and little opportunity to drink during an actual engagement, a man may be already depleted of both salt and water when wounded. If, subsequently, water is withheld, for example because of actual or suspected abdominal penetration, or if, through misguided zeal, the casualty is covered with blankets despite the climate, or even given hot water bottles, following common but erroneous practice, both water and salt loss may become so serious, as a result of excessive sweating, as to deprive the patient of his chance of survival.

It is therefore necessary to decide, not only which is the predominating shock-producing element in any casualty, but also to know, in the oligæmic type, which component of the circulation has been lost. Is it solely blood, is it largely plasma, or is dehydration the important factor? Usually this is fairly obvious from the nature and circumstances of the injury—*e.g.* blood loss from hæmorrhage, serum loss from burns, a combination of concealed blood loss and intra-tissue plasma transudation in many soft tissue wounds and crush injuries, or water-electrolyte deficiency when circumstances have made this probable. However, in most cases multiple factors are operating and all require whole blood, although it is important to know how much this should be supplemented by other fluids. When facilities exist for quick hæmoglobin and blood protein estimation, the following table may be helpful :

Table 1

Type of loss from circulating blood	Hæmoglobin	Serum protein	Urinary output
Blood ... ..	Falls	Falls	Falls
Plasma ... ..	Rises	Falls	Falls
Water and electrolyte ... ..	Rises	Rises	Falls

Before considering the principles of resuscitation, there are certain important physiological facts to be remembered. These are :

- (a) The total vascular capacity, which for an average adult male is approximately 5 litres of actual circulating blood together with a potential capillary capacity of a further 15 litres.
- (b) The renal circulation, which at rest is approximately one-fifth of the cardiac output.

- (c) The compensatory rise in cardiac output as blood hæmoglobin falls. With normal hæmoglobin (14.8 grams per 100 ml.) the cardiac output is approximately 5 litres per minute, but if the hæmoglobin falls to 6 grams per 100 ml., the cardiac output increases threefold to 15 litres per minute.
- (d) The compensatory mechanism by which efforts are made to restore the falling blood pressure. The vascular picture in oligæmic shock is one of widespread vasoconstriction, involving both arterioles and venules, and the predominance of sympathetic tone is in sharp distinction to primary neurogenic shock where parasympathetic tone predominates. The latter condition is a physiological response to trauma rather than a pathological state resulting from it as occurs in secondary shock.
- (e) The fact that urinary secretion (*i.e.* glomerular filtration) ceases when the blood pressure falls below 80 mm. of mercury.

The points of practical importance in shock management are the efficiency of the compensatory mechanism in maintaining blood pressure and circulation in the face of a falling blood volume ; the critical level of 80 mm. of mercury where urinary secretion ceases, and the vast potential capillary reservoir, three times the actual circulating blood, into which blood can be lost when general anoxia leads to capillary dilatation. In the healthy young adult the powers of compensation are considerable and with moderate degrees of blood loss, pressure may be fully maintained ; subsequent hæmoglobin estimation alone indicates the loss which has occurred. The corollary is that when the blood pressure does begin to fall and a neurogenic cause can be excluded, the extensive powers of compensation have been fully exploited and are failing. Should the fall be below 100 mm. of mercury the condition is urgent, and if below 80 mm. critical, constituting a surgical emergency requiring priority treatment.

### THE TYPICAL SHOCK SYNDROMES

There are four well-defined shock syndromes, recognition of which is a necessary preliminary to appropriate treatment. These are :

(a) *Neurogenic shock*, which is characterized by low blood pressure, a slow pulse and cold, pale extremities and lips. Unless complicated by hæmorrhage, it is a transitory condition responding rapidly to rest and analgesia.

(b) *Compensated oligæmic shock*, where there is a rapid pulse, cold, pale extremities and lips, but a normal blood pressure (over 100 mm.). Here physiological readjustments have been able to maintain an adequate circulation, but the case needs blood replacement before operation or further evacuation. Two pints (or litres) should be sufficient.

(c) *Uncompensated oligæmic shock*, where there is a rapid pulse, cold, pale extremities and lips, but a low blood pressure. This condition is dangerous and requires urgent treatment.

(d) *Severe hæmorrhage*, which shows, in addition to a racing pulse and falling

blood pressure, characteristic features of ghastly paleness, intense thirst, dyspnoea, restlessness, mental alertness and such extreme vasoconstriction as to make it very difficult to get a needle into any of the superficial veins because of the spasm.

Needless to say, the latter two syndromes call for immediate, rapid blood transfusion in large amounts. Although severe hæmorrhage presents a fairly characteristic picture, the other three syndromes resemble each other because in each the patient is pale, cold and collapsed. The blood pressure and pulse findings, however, quickly distinguish between them.

### THE DANGERS OF SURGICAL SHOCK

The dangers of surgical shock are three : early fatal syncope, irreversibility and late renal failure (traumatic anuria).

*Fatal syncope* may occur when intense neurogenic stimulation is present, and death may result if attempts are made to move casualties with serious fractures, particularly of the femur, without adequate splinting. It may also occur after extensive burns where many nerve endings are exposed and stimulated. The following case illustrates the danger of continued neurogenic stimulation :

A soldier sustained a compound fracture of the femur when his vehicle left the road. He had to be extricated, carried up the mountain side and taken by truck to a casualty clearing station, where he arrived in less than an hour. The thigh was grossly angulated with the shaft of the femur protruding. He was profoundly shocked although there had been little external bleeding. He died in Reception before transfusion could be started. Autopsy showed no other injury nor evidence of serious blood loss.

*Irreversibility* occurs when, as a result of failing circulation, tissue anoxia reaches an extent when capillaries lose the power of retaining circulating fluid and transudation into tissue spaces occurs. Although true irreversibility can and does occur in older subjects, it appears to be rare in the young adult and most so-called cases in the past had merely received insufficient blood. Aird (1949) says that he never saw a case during the 1939-45 war, and Allen (1943*b, c*) was unable to produce irreversibility in his experimental animals. Massive transfusion in Korea produced recovery in some moribund cases who would have been accepted as in irreversible shock by any previous standard (Prentice *et al.* 1954 ; Crosby, 1953 ; Crosby & Howard, 1954).

*Post-traumatic renal failure* (traumatic anuria) is a comparatively uncommon complication which typically develops several days after injury and carries a high mortality. It occurs when, as a result of loss of circulating fluid, there has been a very low blood pressure of some duration and particularly if this is associated with muscle damage. It is closely related to the crush syndrome, first recognized as a clinical entity during the air raids on Britain in 1940, and will be considered in more detail later.



### THE PRINCIPLES OF SHOCK MANAGEMENT

Having discussed the causes and pathology of shock and its dangers, it is possible to lay down rational principles for shock management. These are :

- Principle I : To eliminate any neurogenic factors which may be operating and to prevent their recurrence.
- Principle II : To restore the volume of circulating blood as quickly as possible and to a level compatible with early operative surgery.
- Principle III : To prevent toxæmia from damaged muscle and to protect the kidneys from its effects.
- Principle IV : To take such measures as are possible to lower the metabolic requirements of the body until normal circulation can be restored.

It is to new and better ways of giving effect to these principles that progress in shock management must look.

### ELIMINATION OF NEUROGENIC FACTORS

The initial vasovagal response (primary shock) is normally a transitory state which, providing the sensory stimulation has not been so intense as to produce fatal syncope, soon passes off, to be followed by a phase of physiological reaction. Much more dangerous is a continuous flow of painful stimuli received centrally from the injured part, and the first principle of shock prevention is to eliminate these completely. This comes second in priority only after the arrest of active hæmorrhage and is achieved by rapid analgesia, followed by effective immobilization of the injured part wherever anatomically or physiologically feasible.

It is now possible, by combining morphine with a morphine antagonist, to administer it safely in dosage adequate to give almost complete analgesia and to maintain this for an indefinite period. This important new pharmacological discovery provides the means of virtually eliminating neurogenic factors in traumatic shock. Of several known morphine antagonists, the most satisfactory appears to be diaminophenylthiazole hydrobromide (D.A.P.T.), which has little effect on the analgesic properties of morphine but exerts a marked and prolonged antagonism to its respiratory depressant effect, and enables large doses of morphine (up to 2 grains) to be given with safety. The resulting analgesia lasts from six to eight hours, after which the dose can be repeated, and there are said to be practically no side effects (Shaw & Shulman, 1955). So far this drug combination appears to have been used only for the intractable pain of late malignancy, but its application to battle casualties may well prove to be an advance of the same order as the introduction of anæsthesia.

The other factor of major importance in eliminating the neurogenic element from wound shock is effective immobilization of the injured part. This means splinting of major limb wounds whether or not bone has been involved. Although of vital importance in the presence of fractured bone, splinting should not be omitted if soft tissue only is involved because these wounds, too, require

maximum rest and protection. For wounds of the shoulder, arm and elbow the thoraco-brachial plaster offers an effective and comfortable method of immobilization. For major lower limb wounds above the ankle there is no better practical way of obtaining immobilization than the Tobruk splint. With these plasters, casualties can be evacuated safely and comfortably for long distances. Wounds elsewhere should be similarly immobilized whenever possible, and the use of a well-padded temporary plaster shell will give the necessary support and protection. Plaster bandages can, of course, be effectively combined with other forms of splinting to ensure maximum fixation.

Plaster used in this way for temporary immobilization should be applied at advanced dressing station or even at regimental aid post level and arrangements made for its provision there. Recently developed polymer reinforced plaster of Paris can give a strong light cast with half the number of bandages ordinarily used.

### RESTORATION OF CIRCULATING FLUID

Urgent replacement of fluid lost to the circulation is fundamental for the prevention and treatment of true surgical shock, *i.e.* oligæmic shock. Of transfusion fluids or blood volume expanders, whole blood is by far the most important. Despite the advances made in transfusion organization and technique during the 1939-45 war, post-war developments have been such that our previous ideas on this subject require reorientation.

Transfusion therapy can be studied under four headings : the types and choice of fluids available ; the quantity required and how and when it should be given ; the hazards of transfusion ; and the methods of storing and supplying transfusion fluids.

### THE TYPES AND CHOICE OF TRANSFUSION FLUID

Blood volume expanders now available fall into five groups :

- (a) Electrolyte solutions, *e.g.* normal saline or normal glucose ;
- (b) Synthetic plasma substitutes such as dextran ;
- (c) Blood plasma and blood serum ;
- (d) Serum albumin ;
- (e) Whole blood.

The principle governing transfusion is that, in general, replacement should correspond to the component of the circulation which has been lost. The usual practice with battle casualties is to start off with plasma or serum, or with one of the plasma substitutes, while blood is being checked for compatibility by direct cross match, and then to switch to blood as soon as this is ready. In FARELF we usually start with saline sufficient only to ensure that the set is working correctly, then quickly give one or two bottles of plasma or dextran, by which time the blood is ready.

*Electrolyte solutions* are retained in the circulation for so short a time as to be of little value except as a very temporary emergency expedient. Their real value comes in maintaining water and electrolyte balance after the blood volume

has been restored, particularly in abdominal wounds where gastric suction has been necessary or when blood loss is complicated, in hot weather, by dehydration and salt loss which is revealed by the fall or absence of urinary chlorides. In these cases, however, the fluid is better given rectally or by mouth.

*Synthetic plasma substitutes* have the advantage that they can be supplied in large amounts, they keep indefinitely, and can be given rapidly. At the same time they are retained in the circulation for a considerable time and are therefore effective in expanding and maintaining the blood volume. They are free from all risk of serum jaundice. They are composed of large inert foreign molecules which in due course must be removed from the blood and if possible from the body.

Dextran is the best plasma substitute at present available. It is a polymerized sugar molecule which is metabolized and not stored in the body. All but 7 per cent. is metabolized within ten days, the remainder within the next few weeks. The other plasma substitute in use is polyvinyl pyrrolidone (P.V.P.) which, although equally good for resuscitation, is not metabolized and is excreted only with difficulty. About one-third is excreted quickly, but 25 to 40 per cent. is stored in the tissues. Dextran has in consequence largely replaced it as the compound of choice for clinical use. The amount given is usually restricted to two pints, after which blood is given, and used this way it is a valuable addition to transfusion therapy.

*Blood plasma or serum* come second only to whole blood as blood volume expanders. Serum is ready for use from the bottle, but plasma is stored dry and must be made up with sterile distilled water or normal glucose immediately before use. Plasma or serum have the great value of providing a highly accessible source of protein which, because of the katabolic phase which follows trauma, is required by the body in large amounts. They have the disadvantage of being a potential source of homologous serum jaundice, and for this reason plasma in particular has been rather under a cloud, although a statistical analysis by Lehane *et al.* (1949) has shown that, since the use of large-pool plasma was discontinued in Great Britain in June, 1945, the incidence of jaundice with small pool plasma (1.3 per cent.) has been so little greater than that with whole blood transfusion as to be not statistically significant. British-made plasma is now prepared in batches each from the blood of no more than ten donors. It is unfortunate that the method of making plasma, by quick freezing and drying, is also ideal for the long preservation of a virus. This is in contradistinction to serum where the virus tends to die out fairly soon after storage in solution. Shaw (1955) says that, in Australia, where both plasma and serum are used in the different States, the incidence of homologous serum jaundice varies with the amount of plasma used. In Victoria, where serum only is used, it is almost non-existent. Attempts to destroy the virus in plasma have so far been disappointing.

Although it has been thought that dried plasma can be kept almost indefinitely, experience in Malaya has been that under certain conditions slow deterioration

occurs and reactions, sometimes severe, follow its use. Storage at room temperature in a tropical climate appears greatly to accelerate this deterioration, and the incidence of reactions was found to be proportional to the length of time the plasma had been kept at room temperature. The reactions were sufficiently severe to produce a considerable loss of confidence in plasma among surgeons and transfusion officers in FARELF at the time. When only plasma which had been in continuous refrigeration since arrival from the United Kingdom was used, few reactions were reported (Clyne, 1954).

*Serum albumin* is a product of blood fractionation and has the advantage that it can be effectively sterilized to eliminate jaundice virus. Blood fractionation is popular in America and Australia, as a valuable source of other blood ingredients, but a serious disadvantage to the general adoption of serum albumin in preference to plasma in war time is that considerably less of the former can be prepared from any given number of donors.

*Whole blood* is by far the best transfusion fluid and it supplies all the components lost. Its only disadvantage is the limited period it can be kept before use, and careful storage technique is necessary to retard the progressive hæmolysis of red cells which occurs when whole blood is stored.

#### THE TIME FOR TRANSFUSION AND AMOUNT REQUIRED

Having decided on the blood volume expander best suited for the particular case, which will depend on the nature of his injury—simple hæmorrhage, extensive soft tissue laceration with blood loss, crush injury, or thermal burns—the question arises as to when transfusion should be given and how much.

On the question of *when* there can be only one answer—as soon as possible, and this should be sooner than has been customary in the past. Surgical shock is a serious progressive condition which, if severe and unchecked, proceeds to a stage from which no recovery is possible, because a vicious circle develops which cannot be broken, and it becomes irreversible shock. The fact that in healthy young adults true irreversibility is now known to be much longer delayed than was formerly thought does not eliminate its danger. Also, quite apart from irreversibility, the time which renal tissue can tolerate anoxia without suffering irreversible change, leading to traumatic anuria, is limited. Shock is easier to prevent than to treat, and the further it develops the more difficult becomes resuscitation. Blood replacement, therefore, is needed at the earliest possible time, which in war means at field ambulance level, at the advanced dressing station. Although, in Korea, favourable conditions during the static phase enabled the Americans to give blood at battalion level, these circumstances were exceptional. The guiding principle for the management of battle casualties in future should be that no case is evacuated from an advanced dressing station while still shocked. This will make resuscitation one of the most important tasks of the field ambulance. Provided blood loss can be minimized by prompt and effective first aid, and that already lost is replaced without delay, while physio-

logical compensation is still able to maintain an effective blood pressure, the development of severe degrees of shock can be prevented in most cases, which much simplifies subsequent management. Shock prevention lies in prompt hæmostasis, effective immobilization and early blood replacement, and the incidence of severe shock among the wounded of a division in action can be taken as a measure of the quality of first aid training among fighting ranks and of the ability of the medical services to provide effective splinting, quick evacuation and prompt blood replacement.

In a division trained in first aid and supported by an efficient field ambulance, organized for blood transfusion when required, casualties suffering from severe shock should be limited to gross multiple wounds, uncontrolled internal bleeding, and extensive soft tissue damage, and making such cases fit for further evacuation will be the main task of resuscitation teams. It has been taught in the past that it is better not to give blood at field ambulance level, but to delay transfusions until arrival at the casualty clearing station, because if a shocked soldier is resuscitated and again relapses, his condition is grave indeed and subsequent resuscitation is difficult. This may be true enough, but to make it a reason against early resuscitation is a dangerous fallacy revealing ignorance of the mechanism of shock production and of the principles of its treatment. One wonders how many lives have been sacrificed in the past to this teaching. Such cases require early replacement and stabilization followed, if necessary, by a continued slow drip during evacuation, in which case a second serious fall in blood pressure should not occur. If it does under these circumstances, it indicates continued concealed blood loss and the casualty would probably have already died had the early transfusion been withheld. Continuous blood replacement and early surgery offer their only hope. Drip transfusion during evacuation is, in practice, not easy to give and for such cases an attendant experienced with drip technique is almost essential.

In the field, blood loss must be assessed clinically from experience and certain rules of thumb. Blood volume estimation is not practicable at field ambulance level, nor is it necessary, and reference to Table 1 will show how unreliable blood hæmoglobin can be except for cases of pure hæmorrhage. The blood pressure gives little indication of the actual amount lost except that, when it falls below 100 mm. and neurogenic causes can be excluded, it means that loss of the order of about a third of the body blood (*i.e.* 2 litres) has already occurred and the considerable powers of physiological compensation are failing. One must not be misled in this by lack of evidence of this amount of external bleeding, because plasma exudation and blood extravasation into damaged tissues can account for an extensive loss of circulating fluid.

The amount of blood needed has often been seriously underestimated in the past. In general, a shocked casualty requires sufficient to restore and maintain his systolic blood pressure at about 110 mm. of mercury and, if compensation has failed, this may take a large amount of blood. The usual practice is to run in two bottles of plasma or dextran as quickly as possible while the blood is got ready, and then to carry on with blood. Experience in FARELF has been

that few medical officers, unless with previous experience of battle casualties, have any real idea of the extent of blood loss in serious wounds, and as a working rule I advise the newly arrived to decide carefully, from the size of the wound, the time since wounding, and from evidence of external bleeding on the dressing, etc., how much blood they think has been lost. Doubling this figure will then be nearer to the truth. This has proved quite a useful rule.

With the assessment of blood loss presenting such difficulty to the inexperienced, it is necessary to have some rule of thumb to work from. I have found the following a useful rough guide :

- (a) After hæmorrhage, compensation fails and the blood pressure falls below 100 mm. when 2 litres ( $3\frac{1}{2}$  pints) have been lost, but the true picture is seen only after neurogenic hypotension has been eliminated ;
- (b) Loss of blood and plasma into damaged tissue can be roughly calculated by estimating the size of the wound or wounds in terms of clenched fist volumes and allowing one pint (0.7 litre) for each fist unit of damaged tissue.

Provided compensation has not failed completely (*i.e.* the blood pressure is still 80 mm. of mercury or over), rapid transfusion of blood estimated as above should restore it, although even this amount may be an underestimation because of the difficulty in deciding how much bleeding has occurred.

If such blood replacement fails fully to restore or maintain the blood pressure, it suggests concealed bleeding and continuous blood replacement is necessary pending operation. But if compensation has already failed and the blood pressure has fallen to 70 mm. or below, the quantity of blood replacement calculated as above is quite inadequate and may have to be at least doubled if resuscitation is to be achieved. Sometimes even doubling is insufficient and in extreme instances massive transfusion has been necessary. The quicker the blood can be given, the less will be required.

The resuscitation of badly shocked battle casualties by massive blood transfusion is a new development which came with the Korean war. Here, the static conditions of the front line during the latter stages and the large amounts of blood available, enabled forward transfusion to be used by the Americans on a quite unprecedented scale, and amounts up to 30 pints of blood were given in some instances (Crosby, 1953; Prentice *et al.* 1954; Crosby & Howard, 1954). The result was the recovery of moribund cases who would otherwise certainly have died. Surprisingly, there were no ill effects reported from such massive transfusions despite the fact that the amount given was several times the total normal body blood. The question arises as to what happens to this blood and how does it, eventually, produce its effect. It used to be thought that generalized increased capillary permeability resulting from anoxia was the basic mechanism of severe shock (McDowall, 1940; Moon, 1944), but this is now doubtful. Should it happen, shock is truly irreversible, but this state, if it occurs at all in the young adult, is now known to be rare. What does occur is extensive capillary dilatation and blood drains into this great pool (15 litres). Added to this is the considerable

loss of blood and plasma into the damaged tissues themselves, and Prentice *et al.* (1954) believed that continued oozing in this way during transfusion and operation accounted for much of the large amounts transfused in their series. In order to get blood into active circulation, it is necessary first to fill the dilated capillaries. The quicker blood can be given, the more is available before it drains into the capillary pool and, by supplying much needed oxygen, it prevents their further dilatation. As the circulation improves and capillary tone is slowly restored, sufficient blood returns to active circulation to compensate for the loss which is continuing into damaged tissues, but apparently never so fast as to threaten to embarrass the circulation. The bulk of the transfused blood remains in the viscera and skeletal muscles until it is actively broken down, as part of the phenomenon of post-traumatic katabolism, to help supply protein components needed for repair. The Surgical Research Team of the U.S. Army in Korea, using red cells tagged with radio-active chromium, found that the liver, lungs and skeletal muscles were important regions where the excess blood was concentrated (Crosby, 1953). The Korean experience with massive transfusion was that heart failure and pulmonary œdema did not occur, although a few patients developed cyanosis and râles for a short time. This ability to withstand massive transfusion was attributed to the physical fitness of young soldiers of that age group (Crosby, 1953). Blood volume estimation following massive transfusion showed no increase above normal despite the large amount given (Prentice *et al.* 1954).

It will be seen that, when compensation has failed, the speed with which blood is given is important because it is necessary here to break a vicious circle. The falling blood pressure, by reducing venous return, leads to a reduced cardiac output which intensifies the capillary anoxia and consequent dilatation, and so further reduces venous return. It is essential to supply rapidly a head of pressure for the heart to pump against. Rapid blood administration has in the past not always been easy to achieve, despite the use of positive pressure and two veins simultaneously, and in the most urgent cases venous spasm may be troublesome. If necessary, a vein should be cut down on and a cannula tied in. Unless given under positive pressure, blood runs in much too slowly for the urgent needs of the severely shocked or exsanguinated, and even the faster-running dextran or plasma are not quick enough. Positive pressure transfusion is essential here both to overcome venous spasm and for speedy restoration of circulating fluid. In the past, this has been achieved by the use of a Higginson syringe, but this is potentially dangerous, with a real risk of fatal air embolism unless the utmost vigilance is observed. A momentary distraction may prove disastrous, and even with it the rate of giving is often still too slow. Recently a satisfactory mechanical transfusion pump has appeared on the market.\* Blood is forced along the tube by rollers on turning a handle. This enables it to be given rapidly and safely under considerable pressure, a pint in under two minutes, and overcomes minor blockages and local spasm. Such an instrument is an essential addition to transfusion equipment and may well obviate the necessity for using the intra-arterial route which was developed to save these urgent cases.

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\* The Martin transfusion pump supplied by Messrs. Allen and Hanbury Ltd.



**Intra-arterial transfusion** has proved life-saving in desperate cases, for which it may in future challenge the intravenous route as the method of choice. The entrance of transfused blood direct to the arterial side immediately raises arterial pressure and, by giving the heart something to pump against, at once improves cardiac output. Intra-arterial transfusion was used by the Russians for reviving shocked casualties during the 1939-45 war and subsequently has been receiving increasing attention. Bingham (1952), reporting over 100 cases, considers it to be far superior to intravenous transfusion. He gives the blood by cannula into the radial or dorsalis pedis artery and advises using heparin as a safeguard against clotting. Wilson, Wallace & Whiting (1952) give similar enthusiastic reports from America; and Brown (1953), using the radial artery, reports 165 cases treated at Edinburgh with better results than obtainable by the intravenous route. Intra-arterial transfusion is more effective in restoring cardiac output than intravenous, and appears to be the method of choice for patients with profound shock or *in extremis* from massive hæmorrhage. Here speed is vital if the patient is to survive, and this outweighs in importance the risk, which is real, of producing arterial vasospasm distally. This may be sufficient to produce gangrene of distal extremities and therefore the left wrist should be chosen. It is considered dangerous to transfuse fluids other than blood in this way. For circulatory collapse during laparotomy, transfusion direct into the aorta or common iliac artery has been life-saving. The use of a transfusion pump with intra-arterial transfusion enables blood to be given rapidly at adequate pressure (120 mm. Hg) without risk of air embolism (Melrose & Wilson, 1953).

In cases with compensated oligæmic shock (*i.e.* blood pressure still over 100 mm.) it is essential to give blood before attempting any surgery, because they may be in the last stages of compensation and further sudden blood loss can be disastrous. The following example illustrates this danger :

A soldier was shot through the elbow, fracturing the lower end of the humerus. He reached hospital six hours later, apparently in good condition, with a blood pressure just over 100 mm. The dressing was soaked in blood but he was not apparently actively bleeding. He was considered fit for surgery and taken to the theatre without preliminary transfusion. At operation, venous bleeding was encountered which welled up from the depths of the wound and could only be controlled by packing. At this stage the patient's condition deteriorated and he went into deep shock. Only then was blood transfusion started and he was returned to the ward with a drip running. He died two hours later, still profoundly shocked.

In this case, the deceptive powers of compensation of a young adult had disguised the gravity of the blood loss. He should have received 2-3 pints of blood before any surgery was attempted and this should have been continued as a slow drip during operation. When he collapsed, massive blood replacement given rapidly, might have saved his life. The surgeon in this case had had no previous experience of battle casualties.

## HAZARDS OF TRANSFUSION

The main complications of blood transfusion are incompatibility, rigors, air embolism, overtransfusion and homologous serum jaundice. Incompatibility

may be either a major mismatch or an intergroup incompatibility. Under field conditions, only Group O blood (universal donor) is supplied for casualty resuscitation and this eliminates the possibility of any major mismatch occurring. Although direct cross-matching is usually done as an extra precaution, it can be omitted in emergencies. Out of the vast amount of blood supplied by the Army Transfusion Service during the 1939-45 war, disasters from blood incompatibility were almost unknown although approximately 10 per cent. of all wounded required to be transfused. This was achieved by meticulous preliminary checking of the agglutinin and agglutigen content of all Group O blood before release (Whitby, 1953). At base hospitals, where facilities for accurate typing and cross-matching exist, type specific blood, if possible fresh, is preferred, particularly when repeated transfusions must be given.

During the Korean war the Americans made an extensive study of blood transfusion, particularly with regard to possible dangers from the large quantities of blood sometimes given. In the U.S. 8th Army, only Group O blood was used. As all Group O blood contains some anti-A and anti-B antibodies, preliminary screening was always done for these agglutinins and it was divided into two sub-groups: high titre Group O (greater than 1 : 200) and low titre Group O. Most blood is of the latter type and is universal donor blood, safe to use for any person, regardless of group, and without any preliminary cross-matching. The use of such blood in forward dressing stations eliminates the delay of cross-matching and the need for skilled technicians to do it. High titre Group O blood is safe to use only with Group O recipients, and this sub-group constitute "dangerous universal donors," because such blood may produce with other groups a hæmolytic transfusion reaction of the major incompatibility type (Steer, 1953 ; Crosby, 1953).

Intergroup incompatibility has now reached such complexity that only skilled and time-consuming cross-matching can eliminate its possibility. Of the various possible intergroup factors, the Rh factor is the most important, but in Korea this was disregarded and accepted as a calculated risk in the forward resuscitation of battle casualties. Fortunately, only about 15 per cent. of subjects are Rh negative and of these even fewer are capable of developing Rh antibodies and then only after multiple transfusions over an appreciable interval of time. It was, however, disregarded only in the field and not when patients reached base hospitals (Steer, 1953).

*Rigors* are common during the administration of both blood and plasma, particularly when given rapidly. The reaction, although alarming to the uninitiated, is innocuous and not an indication for stopping the transfusion, and the rigor nearly always stops when the speed of flow is reduced. If severe, it may be controlled with morphine injection.

*Air embolism* is a real risk when positive pressure transfusion is used and requires unremitting attention to the apparatus if the risk is to be avoided. Pressure should be released when three-quarters of the bottle have been given. The rotary pump avoids this danger.

*Overtransfusion* appears not to be a serious risk in acute casualty resuscitation

in young adults. Cases of compensated oligæmic shock require a prophylactic transfusion of 2-3 pints (1-1½ litres) and no more. Cases of uncompensated shock require rapid continuous transfusion until their blood pressure rises over 100 mm., and until this happens there is no possibility of their being overtransfused, because of the capillary dilatation and exudation into damaged tissues. This is why such large amounts of blood can and must be sometimes given. This, however, is not the case after stabilization has occurred and if transfusion is repeated several days later, in order to correct the post traumatic anæmia which occurs as part of the phenomenon of repair katabolism (Cuthbertson, 1942 ; 1950). Then the blood must be given very slowly to avoid embarrassing the heart. The same precaution applies to burns transfused after the first forty-eight hours, when serum exudation has ceased. The danger of overtransfusion then is real. Subsidiary electrolyte solutions, if needed, are better given rectally or intra-fascially, *e.g.* subpectorally, if they cannot be taken by mouth. If gastric suction demands a continuous intravenous drip, it must be a slow one.

*Homologous serum jaundice* has already been mentioned. It can never be completely eliminated as a risk in whole blood transfusion, although, if donors with a recent history of jaundice are excluded, the risk is relatively small, less than 1 per cent. in England (Lehane *et al.* 1949). The other potential source is plasma and present methods of preparation tend to preserve the virus, but improved techniques may eventually eliminate this source.

#### STORAGE AND DISTRIBUTION OF TRANSFUSION FLUIDS

The supply and distribution of plasma, serum and the synthetic plasma substitutes under field conditions present no special difficulties. Blood, on the other hand, has a relatively short life and any way of increasing the period during which it can be usefully and safely administered is important when blood is needed in large amounts. The changes which occur in bank blood during its storage and transportation and any harmful effects which may result from transfusion of such blood in large amounts was the subject of investigation by the Surgical Research Team of the U.S. Army in Korea (Crosby, 1953 ; Crosby & Howard, 1954).

It is known that, during refrigeration, potassium gradually leaves the red cell and that stored red cells are abnormally fragile when suspended in hypotonic saline. Both these changes have, however, been shown to be reversible. When blood is chilled to 4° C., potassium diffuses out as a result of the much reduced cell metabolism, but if the blood is subsequently warmed and glucose is available, the cell takes up potassium again from the plasma. High plasma potassium in stored blood is thus not necessarily evidence of its deterioration. The increased fragility of stored red cells has been shown to be, in part, a result of this potassium shift and, like it, reversible. After transfusion, the cell regains its normal shape and fragility. On the other hand, plasma hæmoglobin concentration in bank blood appears to be an accurate index of the extent of hæmolysis which has occurred during storage, and plasma hæmoglobin tests show that blood is not

seriously damaged by storage and transport up to three to four weeks, provided adequate refrigeration ( $4^{\circ}$ - $10^{\circ}$  C.) is maintained, and studies in cell survival show that such blood bank cells survive for at least twenty-four hours after transfusion without being hæmolyzed. They are viable and capable of function (Crosby, 1953). British experience in North-West Europe was that blood survived well and could be used up to twenty-eight days from time of collection, but that, unless adequate time were allowed for cells to settle, it was impossible, from inspection, to tell whether or not hæmolysis had occurred and much blood was needlessly discarded as hæmolyzed because of its appearance (Conway, 1953).

During transport of blood, any sudden movement or agitation favours hæmolysis. It has been found that this can be much reduced and the life of the blood appreciably increased by filling bottles right up to the stopper instead of leaving the usual small air space.

For rapid transfusion under field conditions, the use of expendable plastic giving sets is a marked advance which should eliminate most of the troubles that have been the bane of blood transfusion during the Malayan operations—viz. perished rubber, the difficulty of effectively cleaning sets and tubing after use, unexplained reactions and the like. Giving sets in war should be used once only, then discarded.

#### THE PROTECTION OF THE KIDNEYS

Toxic changes in the kidneys leading to a lower nephron degeneration are likely to follow continued low blood pressure, particularly but not only, if associated with muscle damage. The result is renal failure or traumatic anuria which has a high mortality, because death commonly occurs before the kidneys are able to recover from the damage sustained.

Traumatic anuria is closely related to the crush syndrome, first recognized during the blitz in Britain. Its incidence was between 3 and 4 per cent. of air raid casualties, and the common feature in all cases was some form of crushing injury resulting in plasma loss into bruised tissues, sufficient to produce severe oligæmic shock, with which was associated considerable muscle necrosis, mainly ischæmic in origin. Cases surviving the initial shock later developed anuria which was usually fatal. The characteristic renal lesion was a lower nephron degeneration similar to that found after mismatched transfusion, calculus anuria and sulphonamide poisoning, and many of the tubules were blocked with pigment casts of precipitated myoglobin.

It was subsequently found that traumatic anuria was not confined to crush injuries, but that it could complicate ordinary missile wounds where there had been a low blood pressure (70 mm. or less) for a period of the order of two hours or more. Although some muscle damage was always present in these cases, it was no more than in many other wounds. The common feature was the sustained hypotension. Balch, Meroney & Yoshio Sako (1955) have reported twenty-four cases among Korean war casualties, and nine cases have occurred in Far East Land Forces since 1950, five among wounded, three following traffic accidents and one after hæmorrhage. Two of these recovered. The following was typical :

A police officer was shot in the thigh when a train was fired on, fracturing the femur. He received no proper splinting and on arrival at hospital two hours later was profoundly shocked. This was treated by transfusion, and after several hours resuscitation the blood pressure had risen sufficiently for wound toilet and splinting. His immediate post-operative condition was satisfactory with no further fall in blood pressure, but after forty-eight hours he began to develop progressive oliguria with a rising blood urea. This went on to complete anuria and he died twelve days later. This case well illustrates the danger to the kidney of a continued low blood pressure and the urgency of restoring it.

Much speculation has taken place regarding the relative importance of plasma loss into damaged tissues and of vaso-depressant products of muscle necrosis, such as adenosine triphosphate, in causing shock. There has also been considerable discussion as to the actual cause of the renal damage. Green & Stoner (1950) have shown experimentally that the shock-producing effect of adenosine triphosphate injection could be much reduced by the prophylactic administration of large amounts of normal saline solution, but only if this were given before renal damage has occurred. They also showed that the shock-producing action of this compound was much increased by raising the surrounding temperature; an observation which has an important bearing on shock management. Experience from British air raid casualties was that early alkalization of the urine was of real protective value, as was pressure bandaging the crushed limb. Alkalization was obtained by giving bicarbonate by mouth and lactate and plasma transfusion by veins, but it was agreed that in order to achieve success this way, it was necessary to give alkalies before and not after renal damage had occurred (Bywaters & McMichael, 1953).

The treatment of established renal failure is difficult and unsatisfactory. The main danger is a progressive disturbance of the electrolyte balance resulting in potassium intoxication and acidosis. The problem is to tide over the patient until the tubules have had the time to recover, and the usual methods of protein elimination from the diet and encouraging other routes of nitrogen excretion have proved disappointing in these cases. The American Surgical Research Team which investigated the syndrome in Korea tried the artificial kidney for some cases with reported success. Of eighteen cases dialysed, six survived, and it was considered these otherwise would have died, and of the remainder, renal failure was the immediate cause of death in one case only (Balch *et al.* 1955).

Traumatic anuria remains a serious complication of a small proportion of traumatic casualties, battle, air raid or even traffic. The common feature seems to be a continued low blood pressure and, once established, the condition carries a high mortality and is difficult to treat. Prevention therefore must be the basis of management and for this the following rules are useful :

(a) A sustained low blood pressure is a very dangerous condition. Every effort must be made, by prompt effective first aid measures, to prevent it occurring, and if it develops it demands most urgent and energetic treatment to restore the blood pressure before renal damage becomes irreversible.

(b) Cases with extensive muscle damage, specially from crush injury, are

particularly dangerous, partly from the intensity of the shock which develops and may be fatal and partly because of the special risk of traumatic anuria in survivors. They therefore require early surgical treatment, as soon as vigorous resuscitation has made this possible, with excision of necrotic muscle. This is just as important after crush injuries as after flesh wounds.

(c) When a limb has been crushed and the circulation obstructed, a pressure bandage should be applied as the limb is released and kept on until plasma transfusion has been started and the limb can be explored surgically if necessary. Removal of the bandage will produce a sharp fall in blood pressure as blood drains into the damaged tissues, the effect being similar to that of a major hæmorrhage. Added to this sudden blood loss is the vaso-depressant action of released muscle toxins. It is essential therefore to avoid this until plasma or blood can be replaced as quickly as it is lost. The preliminary administration of intravenous saline, together with alkalies by mouth, will help protect the kidney from the effects of released myoglobin. At operation, the extent of muscle destruction resulting from the crush must be determined, non-viable muscle excised, or even amputation performed if it is not considered to be safe to preserve the limb. The subpectoral route is an easy and very effective way of continuing saline while blood is being transfused intravenously and considerable amounts can be absorbed in this way. A rectal drip, provided it is run in slowly, is also a good accessory route.

(d) Temperature plays an important part in determining the speed and extent of muscle necrosis following ischæmia, which is much retarded if the wounded or crushed limb is kept cold until adequate surgical toilet is possible. Deliberately chilling the limb in these circumstances is a rational procedure.

(e) Whenever the blood pressure has remained at 70 mm. or less for over an hour, or if there has been extensive muscle damage, the casualty must be regarded as a case of potential traumatic anuria and measures to protect the kidneys taken from the outset—*i.e.* “push” saline, make and keep the urine alkaline, eliminate protein from the diet and keep the damaged limb chilled. The urinary output and blood urea should then be carefully watched. It is dangerous, however, to continue to “push” fluids once urinary secretion begins to fail, and at this stage the fluid intake should be restricted as a precaution against pulmonary œdema.

#### REDUCTION OF METABOLIC REQUIREMENTS

Peripheral arteriolar constriction is a common feature of all forms of shock and is often associated with sweating. As a result the skin, particularly of the extremities, becomes pale, cold and clammy and the patient may feel cold. Because of this, the warming of casualties with shock, by blankets, hot water bottles or other means, has been long accepted without question as an essential part of shock management. But with increasing experience, many surgeons began to realize that when heating was pressed to the point of causing sweating, it merely increased both the fluid loss and the discomfort of the patient and was doing more harm than good. By the end of the last war, it was generally

advised that heating the patient should be discontinued before it produced sweating. Nevertheless, wrapping a shocked casualty in blankets and applying hot water bottles is still common practice, even in hot climates.

It was during the latter part of the 1939-45 war that the wisdom of actively heating patients in shock was first doubted. It was observed, at Tobruk, that casualties who had been immersed in cold sea water for several hours were usually in better condition than those with similar wounds not immersed (Devine, 1943). Kay (1944) at Glasgow, reported the deleterious effect of overheating shocked cases. Experimental work confirmed these clinical observations. Blacklock & Mason (1941) found that applying heat hastened the death of dogs with shock due to hæmorrhage, while cold delayed, although it did not prevent, death. Wakin & Gatch (1943), at Indiana University, reported that both heat and cold were harmful to shocked animals, while the experimental work of Allen (1943a) showed that not only was a slightly subnormal temperature harmless in shock, but it was probably beneficial. There is thus now considerable evidence, clinical and experimental, that the optimum temperature for a patient with traumatic shock is slightly subnormal, and that any heating should be done with considerable caution and should never produce sweating. A subnormal temperature, by reducing the metabolic requirements of the body, eases the burden on the failing circulation, while at the same time it inhibits the production of vaso-depressants from damaged tissue which may intensify the shock (Green & Stoner, 1950). The skin is always cold and clammy in shock and the patient often feels cold, nevertheless to apply heat may well diminish his survival chances. In hot weather or in the tropics it is absolutely contraindicated and no form of external heat is needed no matter how cold the patient may feel.

During the war in Indo-China, the French carried this a stage further and used controlled hypothermia as a method of treating patients in severe shock and also prophylactically to forestall the development of shock in cases where this was anticipated. Simultaneously blood replacement was essential (Laborit & Huguenard, 1953 ; Creyssel & Deleuze, 1953). Although the rationale is sound to prevent tissue anoxia by reducing metabolic requirements and to inhibit enzyme activity, the risk of causing severe renal damage while doing so must be remembered. However, provided an adequate renal circulation can be maintained by blood replacement and a safe technique developed for maintaining hypothermia with serious battle casualties, artificial hibernation appears to have fascinating possibilities and be worthy of careful investigation and further trial.

### SUMMARY

1. The principles of resuscitation of war-time casualties have been reviewed in the light of recent developments.
2. Revolutionary post-war advances include the use of massive blood replacement and intra-arterial transfusion, mechanical transfusion pumps, the discovery of morphine antagonists and the possible use of controlled hypothermia in the management of shock.



3. With improved methods of prevention and treatment, shock in the future should lose many of its terrors and resuscitation will become one of the most important tasks at field ambulance level.

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# THE TREATMENT OF NERVE-GAS POISONING

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## INTRODUCTION

THE nerve gases are organic phosphorus compounds which possess the property of being potent inhibitors of cholinesterase. They were first synthesized and described by Gerhard Schrader who was searching at I.G. Farbenindustrie in Germany in the 1930s for new synthetic insecticides. During the last war large quantities of one of these compounds, ethyl NN-dimethylphosphoamidocyanidate (Tabun), were stored and ready for use by Germany, and other compounds, such as isopropylmethylphosphonofluoridate (Sarin) and 1-3 : 3-dimethyl-n-butyl 2-methylphosphonofluoridate (Soman), were being actively investigated.

A large amount of research on the physiological, pharmacological, and biochemical aspects of nerve-gas poisoning has now been reported and it seemed desirable to summarize for the service medical officer the pertinent aspects of the published results so that he can have a better understanding of the fundamental basis of suggested therapeutic procedures.

## EFFECTS OF NERVE-GASES

These gases can enter the body through the respiratory tract, the eye or the skin, but, whatever the route of entry, all these compounds produce qualitatively similar toxic effects. A lethal dose of Sarin produces the following picture in the conscious animal. There is muscular fasciculation, followed by inco-ordination, violent convulsive movements, prostration, gasping respiratory movements and signs of "air hunger," engorgement of the veins and often micturition and defæcation. Unconsciousness follows, respiration ceases, the heart slows and the pupils may contract. (Miosis always occurs early if the eyes are exposed directly to the drug.) Then the skin capillaries collapse and finally the heart ceases to beat.

At autopsy the picture is similar for each route of poisoning. The diaphragm is elevated, with the lungs usually collapsed and ischæmic although occasionally they are congested. There is spasm of the small intestine and the abdominal viscera, with peritoneal effusion, and the splanchnic veins are engorged with dark venous blood. The right heart is distended and the left ventricle is usually empty. Apart from the "venous" colour of the arterial blood, the brain is generally normal in appearance, but there are sometimes a few petechiæ in the brain substance.

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The general picture in all the species studied (mouse, rat, guinea-pig, rabbit, cat, dog, monkey, sheep and goat) is characteristic of the asphyxial state and it is evident that failure of respiration is the predominant effect produced by the intoxication.

Impairment of ventilation can occur in three main ways, viz., by the production of bronchoconstriction, through neuromuscular block affecting the respiratory muscles, and because of central respiratory failure. The latter seems to be the predominant factor in most circumstances although the detailed picture varies with the gas used, the dosage administered, etc. (de Candole *et al.* 1953).

Respiration may also be embarrassed during nerve-gas poisoning by the profuse secretion of fluid from the bronchial and especially the salivary glands (Dirnhuber & Cullumbine, 1955). In the unconscious subject some of this fluid might be aspirated into the respiratory tract or, if positive pressure artificial ventilation were applied, might be forced down into the narrower airways and so contribute to blocking them, thus increasing the danger of asphyxia. The occurrence of this possibility is increased by the fact that the cough reflex is abolished in nerve-gas poisoning.

Although the major event in nerve-gas poisoning is the failure of respiration, these agents can cause marked effects on the cardiovascular system. A slowing of the heart with a reduction in cardiac output and a fall in the systemic blood pressure occurs. Accompanying these changes a rise in venous pressure and an initial fall, followed by a gradual return to normal, of the pulmonary arterial pressure are also seen.

### BASIS OF THERAPY

Since the most important effect of the nerve gases is upon the respiratory system and since this and the major effects of the nerve gases are due to the accumulation of acetylcholine following upon the inhibition of cholinesterase, the problem of treatment of nerve-gas poisoning can be approached in several ways.

Obviously artificial ventilation may be required in order to maintain adequate tissue oxygenation. In addition, the actions of acetylcholine could be countered by, for example, atropine or a similarly acting substance. A more fundamental approach would be to reverse the inhibition of the cholinesterase, thus re-establishing normality to the affected physiological mechanisms. Finally, the nerve gas itself could be destroyed or detoxified in the body before it had the opportunity to inhibit cholinesterase.

Atropine has been recommended as the main item for drug therapy. It will prevent and reverse the muscarinic (*e.g.* miosis, bronchoconstriction) and the central effects (*e.g.* paralysis of the respiratory centre) of acetylcholine and of the nerve gases. Full atropinization must be achieved early and must be maintained, additional atropine being required when slowing of the heart suggests that further antagonism to nerve gas was required. Medical officers should therefore have no hesitation in giving repeated doses of atropine if the patient's condition demands it. The nerve-gas casualty can receive relatively large doses of atropine

since acetylcholine is accumulating in large quantities and is not being destroyed by cholinesterase.

It should be noted that atropine will not overcome the peripheral neuromuscular paralysis. This, however, seems to be temporary in nature and function gradually returns to the respiratory muscles in favourable cases. Another point to remember is that the depressed circulatory function may prevent the rapid and complete absorption and distribution of injected atropine to the cerebral and medullary centres.

It has been noted in animal experiments that the effectiveness of atropine varies in different species, with the particular nerve gas used, with the route by which the atropine or the nerve gas is administered, and with the dose of nerve gas applied. One of the main reasons for the variable efficacy may be that the relative importance of the three mechanisms contributing to respiratory embarrassment—bronchoconstriction, neuromuscular block, and central failure—varies between species, between nerve gases and with dosage (de Candole *et al.* 1953). Atropine does not affect the neuromuscular block and, therefore, in those circumstances where this is important, atropine will be less effective. It has been shown, for example, that the reason some fully-atropinized cats die from Sarin is the persistence of neuromuscular block in the respiratory muscles. Monkeys, in which the respiratory failure produced by nerve gases is mainly a central phenomenon, respond well to atropine.

Man, like the monkey but unlike the rabbit and the rat, also responds to small doses of atropine and so, if the picture of nerve-gas poisoning in man is similar to that in the monkey, reasonable doses of atropine may be effective in the therapy of poisoned men.

The dose of atropine sulphate for field use against nerve-gas poisoning must also be considered. Here it must be remembered that death may occur within a few minutes of exposure and early treatment is imperative. Therefore the individual service man must be made responsible for his own treatment. Unfortunately, since the early signs and symptoms of nerve-gas poisoning are vague, it is difficult to advise the service man when to give himself atropine so that this may be administered on suspicion and when no actual exposure has occurred. Since atropine itself has certain undesirable effects in the absence of acetylcholine or anti-cholinesterase poisoning, the dose of atropine which the individual service man can be allowed to use must be a compromise between the dose which is therapeutically desirable and that which can be safely administered to a non-intoxicated person.

Trials under temperate climatic conditions have shown that 2 mg. atropine sulphate is a reasonable amount to be recommended for injection by an individual and that higher doses may produce embarrassing effects such as dizziness, tiredness, difficulty in reading and dysuria, on troops with operational responsibilities (Cullumbine, McKee & Creasey, 1952).

In a warm environment, since atropine inhibits sweating, increases the heart rate and alters the rectal temperature, it would seriously affect the maintenance of body temperature. Therefore a study has been made of the

effect of atropine sulphate on the process of acclimatization to a hot, dry and a warm, moist environment (Cullumbine & Miles, 1953). It was found that 2 mg. atropine sulphate did temporarily disturb acclimatization, especially in the hot, dry environment, but that this effect was less marked as the period of acclimatization was prolonged.

Further trials with fully acclimatized troops showed that not many of them could tolerate 2 mg. atropine sulphate in either a hot, dry or a warm, moist climate. Resting men may remain efficient after this dosage although their eyesight may be affected. If exercise has to be taken, then there will be a general loss of efficiency and some subjects may collapse. If the exercise has to be done while exposed to the direct heat of the sun then a large proportion of the men may collapse and the military efficiency of the remainder will be negligible. These effects of atropine are very temporary and a collapsed man will quickly recover (in about an hour) if he is allowed to rest. This recovery will be hastened by sprinkling water on the skin to aid evaporative cooling.

Despite the temporarily harmful effects produced by atropine in warm environments, 2 mg. atropine sulphate is still recommended as the first aid dose in all climates since it is considered that unnecessary atropinization is preferable to death from nerve-gas poisoning.

Because death occurs so rapidly in nerve-gas poisoning the first aid dose of atropine must be given quickly and with certainty and various self-injection devices have been suggested for this purpose. The intramuscular route of administration is recommended, chiefly on the grounds of ease and rapidity of injection, since the descending order of rapidity of action following administration by various routes is intravenous, subcutaneous, intramuscular and oral.

The efficacy of atropine will be enhanced if artificial ventilation is also applied to the poisoned animal. There are several reasons for this. Adequate oxygenation of the tissues will be maintained and, therefore, the important physiological mechanisms, such as the respiratory centre, will remain responsive to atropine. Thus it has been shown that atropine will only be effective in restoring respiration so long as the degree of asphyxia is not too great. Further, the neuromuscular block, which is unresponsive to atropine, appears to be a temporary phenomenon so that in the absence of asphyxia normal neuromuscular transmission will eventually return.

Moreover, in animals poisoned with nerve gases, atropine also causes acceleration of the heart rate and a momentary rise in blood pressure to a level exceeding its initial value. A fall in peripheral vascular resistance also occurs so long as the pulmonary ventilation is adequate. Without the latter, the blood pressure falls, the heart fails and an increase in peripheral resistance occurs. These effects are probably due to asphyxia because they can be reversed by adequate artificial ventilation. Thus the synergism between atropine and artificial ventilation is again demonstrated. This is because the various important physiological mechanisms are disturbed both by the accumulation of acetylcholine and the development of asphyxia. In addition the absorption of injected atropine may be hampered by local and general circulatory failure.

A positive pressure form of artificial ventilation is recommended because of the possible occurrence of an increased airway resistance due to bronchoconstriction. In man this increased resistance to breathing may be only moderate in degree and of short duration, but it would appear to be essential to avoid any element of asphyxia complicating the picture of nerve-gas poisoning.

Therefore, ordinary manual methods of artificial respiration may be ineffective since they will not overcome the bronchospasm. They may possibly aid, however, to prolong life until other therapeutic procedures can be applied. The Holger-Nielson, arm-lift back pressure, method would seem to be best of the manual methods. It gives adequate pulmonary ventilation, is easy to teach and to learn and can be carried out for a long time by a single operator. The Schafer, prone-pressure, method is unsatisfactory because it provides only a small tidal volume which in many cases is less than the respiratory dead-space. In addition, the ventilation is entirely in the range of the respiratory reserve and would be handicapped when this is reduced and also the ribs may be fractured by this method. The arm-lift, chest pressure, method of Sylvester has the serious disadvantage that the tongue is liable to fall back and occlude the air-way, and also the ribs may be fractured or the liver ruptured. With the hip-lift method of Emerson the tidal volume in some cases is less than the dead-space and the method is fatiguing. The hip-lift, back pressure, method gives a high pulmonary ventilation and can be performed if the arms are injured. The disadvantage is that it soon fatigues the operator especially if he is small and the victim is large. The hip-roll, back pressure, method is less fatiguing but it gives a smaller ventilation and is more difficult to teach and to learn. (Gordon *et al.* 1951*a*, *b*, *c*, *d*; Karpovich & Hale, 1951*a*, *b*; Whittenberger *et al.* 1951; Nims, *et al.* 1951).

A mechanical device is therefore needed to supply the required positive pressure. A continuous positive pressure in the lungs of more than 14 mm. of mercury impairs venous return, but an intermittent positive pressure seems to distribute the blood effectively and it is said to reduce the transfer gradient and to increase the arterial oxygen tension, possibly by promoting more uniform ventilation of the alveoli. Therefore, a manually operated apparatus, such as a bellows resuscitator or a mask-to-mask device, is being considered for field use. Such an apparatus could be easily carried by stretcher-bearers, is simple and quick to apply and use and can be applied to trapped or injured personnel since only the face is needed. It is not fatiguing to use, offers protection from the contaminated atmosphere and will indicate when respiratory obstruction occurs.

Other approaches to the problem of therapy for nerve-gas poisoning are, as stated, an attempt to destroy the nerve gas before it can react with the cholinesterase and an effort to reverse the cholinesterase-nerve-gas combination. Recently two groups of compounds—the oximes and the derivatives of hydroxamic acid—have been found which are capable of doing both those things (Childs *et al.* 1955).

In general the hydroxamic acids are quicker reactors with or destroyers of Sarin than the oximes while the latter are the more potent reactivators *in vitro* of Sarin-inhibited cholinesterase. (Tabun-inhibited cholinesterase cannot be

easily reactivated.) In addition there is evidence that some of the oximes will reverse *in vitro*, but to a less extent *in vivo*, the neuromuscular block caused by Sarin and that this reversal appears to be due to reactivation of the inhibited cholinesterase at the neuromuscular junction (Holmes & Robins, 1955).

Unfortunately many of these compounds, and particularly the oximes, have toxic actions of their own so that only small doses can be given to the whole animal. However, even these limited doses do show some prophylactic and therapeutic effectiveness in Sarin-poisoned animals. They are even more effective when used in conjunction with atropine. This synergism was to be expected since atropine does not affect the neuromuscular block but the oximes may.

It is perhaps too early to define the exact position of the oximes (or the hydroxamic acids) in the therapy of nerve-gas poisoning. Atropine is established as the Mark I therapy. Oximes could be given either as substitutes or as adjuncts or prophylactically. Their best role must be the subject for further research. There is no doubt, however, that for most practical purposes an effective therapy is available. With atropine, artificial ventilation and oximes available, adequate treatment of the degree of intoxication likely to be received in the field should be possible. This treatment will, nevertheless, have to be given rapidly since death from nerve gas occurs in a matter of minutes.

### CONCLUSIONS

The nerve gases are organo-phosphorus compounds which inhibit cholinesterase and so allow acetylcholine to accumulate in the tissues.

Death from nerve-gas poisoning is due to respiratory failure.

Atropine is an effective therapy since it will prevent many of the actions of acetylcholine.

Positive pressure artificial ventilation will augment the effectiveness of atropine in severe cases of poisoning.

Certain oximes and hydroxamic acids will reactivate the inhibited cholinesterase and also hasten destruction of the nerve gas. They show promise of being useful adjuncts to atropine for therapy.

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## THE USE OF SODIUM GENTISATE IN ACUTE RHEUMATIC FEVER

BY

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SODIUM gentisate is a drug of particular value in the treatment of acute rheumatic fever, but its use is certainly not as widespread as its efficiency would seem to justify. It was therefore decided to carry out a small pilot trial employing the two more commonly used drugs, aspirin and sodium salicylate, and sodium gentisate. Whereas the results of this trial are not statistically significant, they are of decided interest in demonstrating how the latter drug compares with the two former drugs in the treatment of acute rheumatism.

Three groups of patients were used, each group consisting of three cases of acute rheumatic fever. The cases were not selected in any way as to first or subsequent attacks, presence of clinical carditis, or length of history, etc., but were just treated with one of the three drugs as they came into hospital. Brief case histories of these patients are given below.

### GROUP I—ASPIRIN THERAPY

#### Case 1

B. V., aged 18, was admitted to hospital with a two-day history of acute pain and swelling in his right knee, followed one day later by pain in his left knee. For one week prior to these symptoms he had a "cold in the head." There was nothing relevant in his past history.

Examination revealed a temperature of 100° F., limitation of movement in both knees with an effusion in the right knee, and a soft, blowing, apical systolic murmur.

Laboratory investigations: E.S.R. 21 mm./hr. (Westergren); W.B.C. 12,900 per cu.mm. with 88 per cent. neutrophils, 11 per cent. lymphocytes and 1 per cent. monocytes; hæmoglobin was 90 per cent. (Sahli).

He was considered to have a mild attack of rheumatic fever and was started on aspirin, 20 gr. five times daily. In two days he became asymptomatic, his E.S.R. had returned to normal limits after fourteen days, and four weeks after admission his aspirin was stopped. On discharge his apical systolic murmur was gone and there was no clinical evidence of residual cardiac involvement.

### *Case 2*

E. P., aged 21, complained of flitting pains in his knees, ankles, wrists and shoulders for two days. He had a sore throat three weeks previously. He had already had two previous attacks of acute rheumatism at the age of 10, when he was in hospital for nine months, and at the age of 15, when he was in hospital for six months.

Examination showed that most of his joints were painful on movement, but there was little swelling. There was a loud apical systolic murmur. His E.S.R. was 101 mm./hr. (Westergren); W.B.C. was 6,200 per cu.mm. with a normal differential count, and his hæmoglobin was 80 per cent. (Sahli).

Treatment was commenced with aspirin, 20 gr. five times daily. His joint pains took five days to disappear, but on the fifth day of treatment he complained of nausea and tinnitus. The aspirin was reduced to 15 gr. doses and he lost his nausea and tinnitus in several days, but developed a slight recurrence of pain in his knees and ankles. The aspirin was then increased to 20 gr. doses again. His E.S.R. fell to normal within four weeks but then steadily rose again and did not return to normal until ten weeks after admission—aspirin therapy was continued during this time. The apical systolic murmur became inaudible and there was no evidence of residual cardiac involvement.

### *Case 3*

A. A., aged 18, was admitted complaining of pain and stiffness in both ankles following exertion, and pain in his right elbow.

On examination he was febrile, both his ankles were red, painful and swollen, and his right elbow was tender on palpation. He had marked tachycardia, a loud apical systolic murmur, and a low-pitched soft mitral diastolic murmur.

Laboratory investigations: E.S.R. 42 mm./hr. (Westergren); hæmoglobin 80 per cent. (Sahli); W.B.C. 5,000 per cu.mm., with normal differential count. He was treated with aspirin, 20 gr. five times daily, but after two days he developed anorexia and tinnitus, and his aspirin was reduced to 15 gr. doses. Tinnitus persisted and his aspirin was further reduced after three more days to 10 gr. doses. His joint symptoms took a week to disappear, and his E.S.R. was down to normal in three weeks. The mitral diastolic murmur became inaudible a few days after admission, but his apical systolic murmur remained loud and probably indicated organic mitral valve disease. Aspirin was continued for eight weeks.

## GROUP II—SALICYLATE THERAPY

*Case 4*

R. C., aged 19, had a four-day history of flitting pains in both ankles and both knees. There was nothing relevant in his past history.

On examination he was febrile and had effusions in both his knees and ankles. There was a loud basal pericardial friction rub but no other abnormal cardiac signs.

Laboratory investigations : E.S.R. 49 mm./hr. (Westergren) ; W.B.C. 9,000 per cu.mm. with 76 per cent. neutrophils, 20 per cent. lymphocytes and 4 per cent. monocytes ; hæmoglobin 111 per cent. (Sahli).

Treatment was commenced with sodium salicylate, 30 gr. five times daily. He lost his joint pains within a week, but his effusions took three weeks to disappear. After six days of treatment he developed tinnitus and acidotic breathing, which were relieved by stopping his salicylate for forty-eight hours and giving him sodium bicarbonate, 60 gr. four-hourly. His E.S.R. became normal after four weeks of treatment. The pericardial friction rub persisted and was present on discharge from hospital. There were no other abnormal cardiac signs. Total length of salicylate therapy was ten weeks.

*Case 5*

A. D., aged 16, complained of pain in his jaw and both legs for several days. He said he had never had chorea or rheumatic fever.

On examination he had a temperature of 101° F., no abnormal joint signs but definite cardiac signs—an enlarged heart with a "left ventricular" type of impulse, a low-pitched, early, blowing, basal diastolic murmur and a loud apical systolic murmur. He had a pulse pressure of 60 mm. of mercury. These signs pointed to active carditis with aortic reflux.

Laboratory investigations : E.S.R. 98 mm./hr. (Westergren) ; W.B.C. 14,700 per cu.mm. with 72 per cent. neutrophils, 20 per cent. lymphocytes, 6 per cent. monocytes and 2 per cent. eosinophils ; hæmoglobin 97 per cent. (Haldane).

He was treated with sodium salicylate, 30 gr. five times daily. His symptoms disappeared in four days, but six days after treatment was commenced he began to vomit and showed slight hyperpnœa. His salicylate was reduced to 20 gr. doses and he was given sodium bicarbonate, 30 gr. with each dose. His toxic manifestations disappeared within a week. His E.S.R. took twelve weeks to become normal, but his cardiac signs did not change and he left hospital with definite evidence of aortic regurgitation. Sodium salicylate, 100 gr. and sodium bicarbonate, 130 gr. daily, were continued for four months until the boy started to get up, when the drug dosage was reduced to 60 gr. and 90 gr. respectively. Total course of treatment lasted for five months.

*Case 6*

R. C., aged 15, complained of anorexia, malaise, sweating and pain in his left knee and right ankle for two days. He had a sore throat five days previously. There was no relevant past history.

On examination he was febrile, and had tenderness and limitation of movement in his left knee and right ankle. He also had a soft, blowing, apical systolic murmur.

Laboratory investigations: E.S.R. 31 mm./hr. (Westergren); W.B.C. 13,900 per cu.mm. with 83 per cent. neutrophils, 12 per cent. lymphocytes, 3 per cent. monocytes and 2 per cent. eosinophils; hæmoglobin was 92 per cent. (Haldane).

He was started on a mixture of sodium salicylate, 30 gr. and sodium bicarbonate, 30 gr. five times daily. His E.S.R. took five weeks to become normal and his progress was interrupted by several attacks of tachycardia, but these disappeared with complete bed rest. Full dosage of drugs was maintained for six weeks and then the mixture was reduced to thrice daily administration. He left the hospital with no evidence of residual cardiac involvement. Total course of salicylate therapy was eight weeks.

### GROUP III—SODIUM GENTISATE THERAPY

#### *Case 7*

H. A., aged 19, complained of pain in first his left ankle and then both knees, in the previous three days. He had a sore throat three weeks before admission. No relevant past history was elicited.

On examination he was febrile, had a red, swollen, tender left ankle containing fluid, and a tender right knee. His heart was normal.

Laboratory investigations: E.S.R. 49 mm./hr. (Westergren); W.B.C. 7,400 per cu.mm.—with normal differential count; hæmoglobin 110 per cent. (Haldane).

He was started on sodium gentisate, 2 grams five times daily; he lost all joint pain in two days, and his gentisate was reduced to 1 gram thrice daily. His ankle effusion was gone in three weeks. There were no toxic effects of the drug. He left the hospital with no evidence of cardiac involvement. Total length of drug therapy was six weeks.

#### *Case 8*

G. H., aged 23, had a two-week history of malaise, and flitting pains in both elbows, both knees, both hands and both feet. There was no relevant past history.

Examination showed bilateral effusion and limitation of movement in his knees and slight swelling of both ankles. There were no abnormal cardiac signs.

Laboratory investigations: E.S.R. 33 mm./hr. (Westergren); W.B.C. 9,800 per cu.mm. with 69 per cent. neutrophils, 27 per cent. lymphocytes, 2 per cent. monocytes and 2 per cent. eosinophils.

He was started on sodium gentisate, 2 grams five times daily. His joint pains disappeared in two days, and after one week his knee effusions had absorbed. His gentisate was reduced to 1 gram thrice daily, and his E.S.R. was normal in two weeks. There were no toxic effects of the drug. On discharge there was no evidence of cardiac involvement. Length of gentisate therapy was four weeks.

## Case 9

R. G., aged 11, was admitted with headaches and pain in both shoulders and elbows for two days. There was no relevant past history.

On examination he was febrile, and had tenderness on palpation and limitation of movement in both shoulders. His elbows were normal. His heart was normal.

Laboratory investigations : E.S.R. 27 mm./hr. (Westergren) ; W.B.C. 5,000 per cu.mm. with normal differential count ; hæmoglobin 102 per cent. (Haldane).

He was given sodium gentisate, 2 grams five times daily. Within three days he had lost his joint pains and within two weeks his E.S.R. was normal. He had no evidence of cardiac involvement. There were no toxic effects of the drug.

## DISCUSSION

Gentisic acid is a biological product of salicylate metabolism, and it is to Meyer and Ragan in America that credit is due for the first recognition that the sodium salt of gentisic acid had valuable anti-rheumatic properties (Meyer & Ragan, 1948). Its action is essentially that of salicylate, but it has the advantage of a virtual freedom from toxic effects even with very large doses of the drug.

To enable a rapid comparison to be made of the various important factors in the treatment of these cases, a table is given (Table 1). This indicates the drug used, the length of time required for relief of symptoms and fall of E.S.R. to normal, the presence of drug toxicity and the total duration of treatment.

Table 1.

Case	Drug used	Relief of Symptoms (Days)	Fall of E.S.R. (Weeks)	Drug toxicity	Length of treatment (Weeks)
1	Aspirin	2	2	None	4
2	Aspirin	5	10	Nausea, tinnitus	10
3	Aspirin	7	3	Tinnitus	8
4	Sod. salicylate	7	4	Tinnitus, acidosis	10
5	Sod. salicylate	4	12	Vomiting, acidosis	20
6	Sod. salicylate	6	5	None	8
7	Sod. gentisate	2	3	None	6
8	Sod. gentisate	2	3	None	4
9	Sod. gentisate	2	2	None	8

Taking these points in turn, it will be seen firstly that the average length of time for relief of symptoms was less using sodium gentisate than with either of the other two drugs. Similarly the average period required for a fall of E.S.R. is less with sodium gentisate.

Drug toxicity in the form of anorexia, nausea, vomiting, tinnitus or acidosis was present in two cases of each group having aspirin and sodium salicylate respectively. These toxic manifestations occurred with the usual therapeutic doses of the drugs recommended by most authorities. No toxic effects occurred

at all with the sodium gentisate even with the high dosage of 10 grams daily. Finally the average duration of the treatment was less in the gentisate group than in either of the other two groups.

It will be seen from these results that there certainly appear to be greater advantages associated with the use of sodium gentisate than with either aspirin or sodium salicylate in acute rheumatic fever. Other successful trials have been carried out by Camelin *et al.* (1950).

Other advantages are claimed for sodium gentisate, although these were not investigated in this present small trial. Apart from the virtual absence of toxic effects such as gastric intolerance, there is no tinnitus or disturbance of acid-base equilibrium and no significant increase in the prothrombin time. Furthermore, concurrent administration of sodium bicarbonate appears to cause an increased absorption and decreased excretion of gentisate in marked contrast to the accelerated excretion of salicylate under similar conditions.

The initial dosage in acute cases of rheumatic fever is usually 2 grams five times daily, but in very severe cases the dosage may even be increased to 2.5 grams six times daily. When the acute symptoms are over and clinical improvement has been achieved, the average maintenance dose is 1 gram thrice daily.

It would thus appear that sodium gentisate is the drug of choice in the therapy of acute rheumatic disease. It must be emphasized, however, that no selection of cases was employed in this trial, the cases merely being treated with one of the three drugs as they arrived in hospital. A further, more intensive investigation is certainly warranted with some attempt to classify the cases in accordance with degrees of severity, first or later attacks, and presence or absence of clinical carditis.

### SUMMARY

A small pilot trial has been conducted in which a comparison was made between the use of aspirin, sodium salicylate and sodium gentisate in the therapy of acute rheumatic fever.

Sodium gentisate appeared to be superior to the other two drugs in the disease, but a further more intensive investigation is needed to assess its full clinical value.

I am indebted to the Anglo-French Drug Co. Ltd. who kindly supplied the sodium gentisate, and in particular to W. H. Gerrie, Ph.C., M.P.S., of that company who has given me every possible assistance in this trial.

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# SOME OBSERVATIONS RELATING TO THE STERILIZATION OF SYRINGES

## I. BY AUTOCLAVING

BY

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## INTRODUCTION

It is generally accepted that syringes can be effectively sterilized by autoclaving, provided certain basic conditions are observed. There is, however, still some divergence of opinion on certain details connected with the procedure. Instructions on the preparation of syringes for autoclaving vary particularly in regard to whether they can be packed assembled or not. The Medical Research Council's War Memorandum No. 15, *The Sterilization, Use and Care of Syringes* (1945), states that packing for autoclaving should be as for hot air sterilization, *i.e.* syringes should be lubricated and assembled. Alexander & Rollason (1955) found that spore-contaminated, assembled syringes, some of which were oiled, were sterilized at temperatures of 120° C. at a pressure of 20 lb. for twenty minutes [*sic*] except in two instances where the autoclave concerned was old. Other workers point out that as sterilization depends on penetration of steam to all parts, syringes must be taken apart before autoclaving (*Lancet*, 1955; Darmady & Hughes, 1955). In order to overcome this difficulty it has been recommended (War Office, 1956) that syringes should be assembled wet to promote the production of steam throughout the syringe during autoclaving.

This paper reports investigations into the problems of the preparation of syringes for sterilization and also includes a few observations on indicators of autoclave efficiency.

## EQUIPMENT

*Electric laboratory type autoclave.* A standard vertical model with a thermostat, pressure gauge and dial thermometer was used.

*Maximum thermometer.* This was inserted into a test tube plugged with cotton-wool and was placed in the centre of the syringes to be sterilized.

*All-glass and nylon syringes.* A selection of 2, 5, and 10 ml. syringes was used.

*Contaminating organism.* This was an aerobic spore-bearing organism, *Bacillus cereus*, obtained from the National Collection of Type Cultures (N.C.T.C. 9687) in response to a request for a suitable organism. It was grown in the medium recommended by Stokes (1955) for the production of spores. The presence of numerous spores was confirmed by a stained film. The spores of *B. cereus* were found to be more heat resistant than the spores of *Bacillus subtilis*, which in our experience were relatively easily destroyed.



## METHOD

The method in each experiment was similar. Half of the syringes were lubricated with silicone M.S. 550. All syringes had a needle mounted and each was placed in a glass tube plugged with cotton-wool. The syringes were first sterilized to eliminate extraneous organisms and then contaminated.

*Experiments 1 and 2.* Contamination was carried out by drawing up and then ejecting the culture followed by dipping the plunger into the culture (to ensure contamination of the washer on nylon syringes). The plungers were replaced in their barrels. These syringes were regarded as "assembled wet."

*Experiments 3 and 4.* The plungers were contaminated by dipping them into the culture and were then dried at 37° C. before being replaced in their barrels. These syringes were regarded as "assembled dry."

*Experiment 5.* The centrifuged deposits of several cultures were pooled and freeze-dried. The plungers were ground in the freeze-dried spore mixture in a sterile petri dish and the syringes assembled.

*Experiment 6.* The syringes were contaminated as for experiments 3 and 4 but were not reassembled until after sterilization.

The syringes were autoclaved at a temperature as near as possible to that usually recommended, *i.e.* 120° C. (15 lb. pressure) for twenty minutes (Medical Research Council War Memorandum No. 15, 1945 ; Ministry of Health Report, 1954 ; War Office Memorandum, 1956). After autoclaving, the syringes were tested for sterility by drawing up broth into the syringe and returning into its original container all but a few drops. Three drops were placed on an agar plate and spread out. Finally the plunger was dipped into the broth. All cultures were incubated for forty-eight hours. Turbid cultures were plated out and in several instances the recovery of the contaminating organism was confirmed by biochemical reactions.

Control syringes, all-glass and nylon, lubricated and non-lubricated, were used in each experiment and these differed from the test syringes only in that they were not autoclaved.

## RESULTS

Table 1 shows the number of syringes from which *B. cereus* was recovered (numerator) and the total number of syringes used (denominator). The contaminating organism was recovered from all control syringes.

Table 1. *Recovery of B. cereus from Contaminated Syringes*

EXPERIMENT	Pressure lb. per sq. in.	Autoclave dial Temperature C.	Maximum Thermometer C.	ALL GLASS		NYLON	
				Lubricated	Not lubricated	Lubricated	Not lubricated
1. Assembled wet ...	16.5	120	120	0/6	0/6	0/6	0/6
2. Assembled wet ...	16.5	119	119	0/6	0/6	0/6	0/6
3. Assembled dry ...	16.5	120	119	4/6	0/6	0/6	0/6
4. Assembled dry ...	16.5	120	119	6/6	0/6	1/6	0/6
5. Assembled dry ...	16.5	120	119	3/6	0/6	0/6	0/6
6. Unassembled dry ...	16.5	120	119	0/5	0/5	0/5	0/5

Numerators = total number of syringes infected.  
Denominators = total number of syringes tested.

## INDICATORS OF AUTOCLAVE EFFICIENCY

Sterilization by steam is dependent on penetration, temperature and time, thus **any** really effective indicator should operate only if all three conditions are satisfactorily met.

A commercially produced (American) indicator which it was claimed changed colour by segments after varying exposures to pure steam at 250° F. (15 lb. pressure) has been tested. When placed in the centre of a drum of dressings and autoclaved, the segments of these indicators changed colour approximately in the times claimed. Further tests, however, with the indicators in screw-capped bottles containing anhydrous copper sulphate gave results which suggested that colour changes occurred under conditions where the concentration of steam was probably relatively low. They were unaffected by dry heat as they could be left in the hot air oven at 160° C. for several hours without any change being detected.

## DISCUSSION

Sterilization of syringes by autoclaving requires the access of pure steam to all surfaces. The lubrication of dry syringes tends to result in a seal between the barrel and the plunger so that the effective penetration of steam is prevented and, as the results in Table 1 show, sterilization is not always achieved. It would appear that steam can penetrate into unlubricated syringes as these were successfully sterilized in all tests. The quality of the syringe, especially the precision with which the plungers and barrels fit, may well be a factor in determining the penetration of steam into unlubricated syringes and may account for the varying results obtained by different workers. When the syringes are assembled wet, sterilization results presumably from steam generated in the syringe.

It will be noted that in our experiments the contamination was carried out after the syringes were lubricated. The results might have been even less satisfactory if the syringes had been lubricated after contamination as the organisms would then have been even more protected from steam by the water-repellent silicone. Protection for bacteria can also be provided by dirt, coagulated protein, etc. Thus it would be wise to insist that if syringes are to be sterilized assembled in an autoclave they should be thoroughly clean, unlubricated and wet.

Bowie (1955) has recently drawn attention to the unsatisfactory design and performance of many of the autoclaves in general use. In discussing sterilizing efficiency tests he dismisses chemical devices as being unreliable. It is true that many of these give no indication of the actual presence of steam and are therefore only of use as an indication that the material in which they are packed has passed through an autoclave. The American indicator used in our experiments, while not affected by dry heat, appears to change colour with mixtures of steam and air. The method of testing employed was somewhat crude and it is suggested that further work with more exact apparatus is warranted before these indicators are rejected. At present therefore we are left with bacteriological tests although these have obvious disadvantages, *e.g.*, delay and lack of agreement on a standard spore preparation.

## CONCLUSION

Autoclaving at 15 lb. pressure for twenty minutes frequently failed to sterilize all-glass syringes lubricated and assembled dry and could not be relied upon to sterilize nylon syringes similarly prepared.

Autoclaving at 15 lb. for twenty minutes sterilized all-glass and nylon syringes assembled dry and unlubricated. This result may be due to the make of syringe used.

Autoclaving at 15 lb. for twenty minutes sterilized all-glass and nylon syringes assembled wet.

A commercially produced indicator of autoclave efficiency has been tested. Further information is required on the proportion of steam necessary to effect a colour change.

I wish to thank Brigadier G. T. L. Archer, M.R.C.P.I., Q.H.S., for suggesting this investigation, and Corporals Burt and Goodwin, R.A.M.C., for technical assistance.

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## INTRALOBAR SEQUESTRATION OF THE LUNG

## A REPORT OF TWO CASES

BY

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An intralobar sequestration of the lung is a defect consisting of a partial or complete developmental separation of a portion of the lobe of the lung from its continuity with the bronchial tree. It is supplied by a large thin-walled artery usually arising from the thoracic or abdominal aorta, but occasionally from smaller vessels such as the intercostal or phrenic artery.

Since Pryce Sellors & Blair (1947) described several such cases, the condition has been more often sought and more often recognized. As the diagnosis is rarely confirmed prior to thoracotomy, we believe that this developmental defect occurs



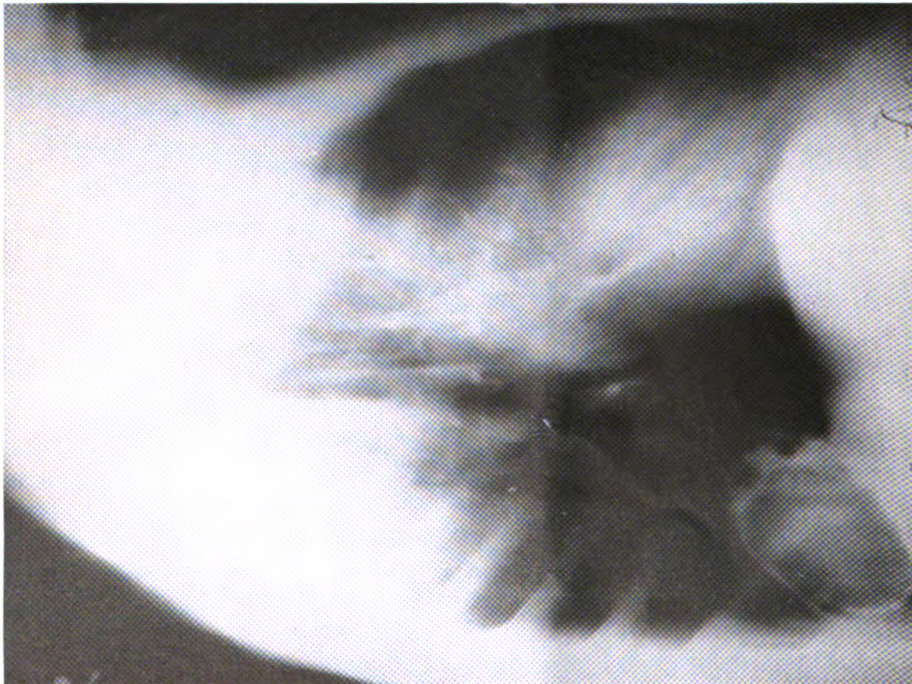


Fig. 1

FIG. 1. Right lateral tomograms showing cystic area in posterior basal segment of the right lower lobe.  
 FIG. 2. The lower lobe after its removal at operation. The pulmonary artery has been filled through the cannula *A* and the aberrant vessel off the aorta through cannula *B*.

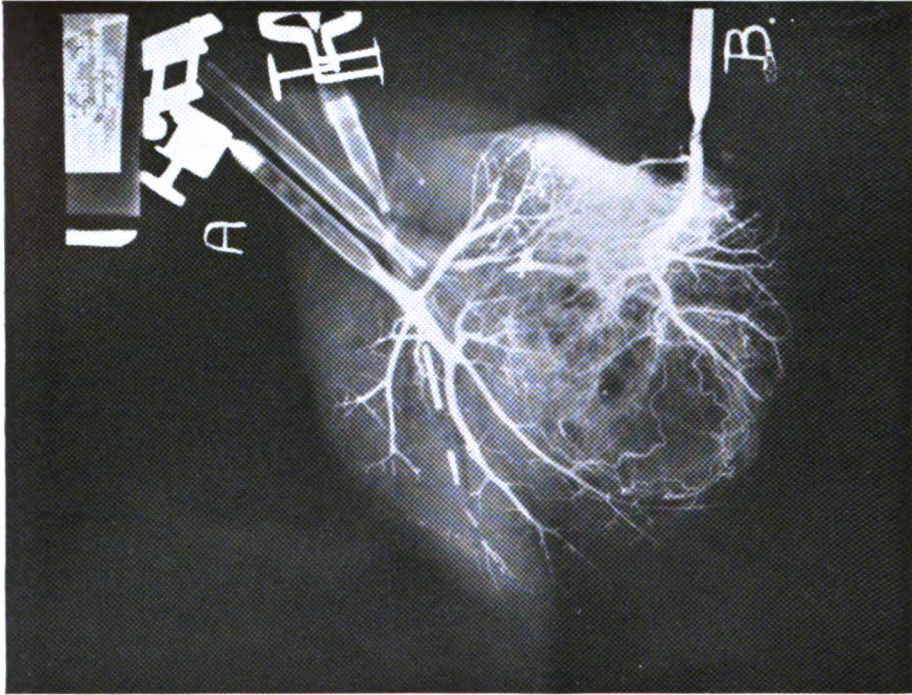


Fig. 2

CASE 1.

PLATE I

more commonly than was once supposed. Below are recorded two such cases that were treated in the Army Chest Centre during 1955.

*Case 1.* A 19-year-old National Service private, with no previous history of chest symptoms, reported sick in 1954 complaining of malaise, sweating, a non-productive cough and right-sided pleuritic pain. He was admitted to hospital with a diagnosis of pneumonia, his physical signs and chest radiographs suggesting consolidation of the right lower lobe. On penicillin therapy he made a rapid symptomatic recovery, but his chest radiographs were slow to show any improvement. Three weeks after his admission to hospital he developed a productive cough, bringing up large quantities of thick purulent sputum. His chest films now showed a cavitated lesion in the posterior basal segment of the right lower lobe. He was considered to be a post-pneumonic lung abscess and was treated with continued chemotherapy and posture. In May, 1954, he was discharged from hospital, his chest radiograph having returned to normal.

He remained quite well, apart from a slight productive cough, until April, 1955, when he again complained of right-sided pleuritic pain. He was admitted to the Army Chest Centre on 26th May. He had no abnormal physical signs. His white cell count and E.S.R. were normal; chest radiography, including right lateral tomograms, revealed a large cystic area of lung situated posteriorly in the right lower lobe. The bronchogram showed that these cysts communicated with the bronchial tree by way of the posterior basal segment bronchus.

On 27th July a right lower lobectomy was performed by Mr. Kent Harrison. At operation it was found that the cystic lesion occupied the posterior lateral aspect of the lobe and was supplied by a large thin-walled artery appearing through the aortic opening, running adjacent to the aorta, and reaching the lung through the inferior pulmonary ligament.

*Case 2.* A 45-year-old major with a four-year history of a "smoker's" cough, producing a teaspoonful of purulent sputum daily, reported sick in September, 1955, after having suddenly coughed up about half a pint of blood. He was admitted to hospital, where chest radiography (including full plate tomograms) revealed a cystic area of lung apparently in the posterior segment of the left lower lobe. A bronchogram showed that the cysts communicated with the bronchial tree via the posterior basal segment bronchus. Bronchoscopy was normal.

On 21st November Mr. Kent Harrison removed the basal segments of the left lower lobe. At operation the lobe appeared normal from the surface, but an ill-defined mass was palpable in its base, posteriorly. A large artery was found to come off the aorta just above the level of the diaphragm and reach the sequestered segment by way of the inferior pulmonary ligament.

## DISCUSSION

The two cases described above are typical of this condition, the first case illustrating the point made by Abbey Smith (1955) that the fact that the chest radiographs return to normal after an acute inflammatory episode does not rule out the diagnosis of sequestered lung segment.

Cases have been described in all age groups. Occasionally they are discovered

on routine chest radiography. More often, the condition is discovered during the investigation of recurrent chest infections, persistent cough or repeated hæmoptyses. The lesion is more often found in the region of the posterior basal segment of the left lower lobe and may consist of a large thin-walled cyst, multiple cystic areas or a mass of tortuous dilated bronchi running along the course of the aberrant artery. They may, or may not, communicate with the normal bronchial tree. The diagnosis is rarely confirmed before thoracotomy except in those cases where an angiogram reveals the presence of the aberrant vessel.

*Development.* It is generally believed that the defect occurs between the fifth and seventh week of embryonic life when the laryngo-tracheal tract grows ventrally from the caudal end of the foregut. At this stage the dorsal aorta communicates through small vascular channels with the vessels surrounding the embryo lung by way of the area vasculosa which is the plexus of vessels surrounding the primitive gut. It is the persistence of such a communicating channel that accounts for the aberrant artery that supplies the sequestered segment. A commonly accepted theory is that the aberrant artery is the prime factor in the subsequent development of the abnormal lung (Pryce *et al.* 1947). On the other hand, it has been put forward that the primary exclusion of a primitive lung bud with subsequent loss of pulmonary artery supply would account for a compensatory persistence of a systemic (aortic) vascular supply (Jones, 1955).

*Pathology.* In both cases described the pathological changes were similar, in that the lesion consisted of thin-walled cysts surrounded by fibrotic lung tissue and communicating with the normal bronchial tree by way of tortuous and dilated bronchi.

#### TREATMENT

In all cases surgery is advised as these congenital defects tend to become repeatedly infected or they may be the source of a massive hæmoptysis. It is important in all suspected cases to find and ligate the abnormal vessels. Several cases have been recorded where the vessel coming through the diaphragm has been inadvertently cut, with a resulting fatal hæmorrhage.

#### SUMMARY

Two cases of intralobar sequestration of the lung are described. The condition is more common than was once supposed and should be suspected in all cases of isolated cystic disease of the lung, especially when situated in the posterior basal segments of the lower lobe.

I am indebted to Lieut.-Colonel S. E. Large, M.B.E., M.R.C.P., R.A.M.C., for his encouragement, and to Captain F. W. O'Grady, R.A.M.C., for the laboratory reports.

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## A FEW COMMENTS ON PULMONARY TUBERCULOSIS

BY

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THERE is little doubt that the time is opportune for a review of the nomenclature of tuberculosis as well as for a statement in respect of the modern approach to pulmonary tuberculosis.

The primary phase, consisting of the primary focus plus glandular component comprising the primary complex, begins as soon as infection has occurred and lasts until the immunological changes have taken place and allergy to *Mycobacterium tuberculosis* has developed. That normally lasts a matter of a few weeks. The post-primary phase includes further advance of the primary focus, dissemination as well as superinfection.

In their approach to pulmonary tuberculosis many do not appreciate that a period of apparent quiescence is a normal part of the natural history of this disease. It is believed that 90 per cent. of the natives of the United Kingdom inevitably become Mantoux positive at some age or another. Furthermore, it is not known what percentage of these cases with radiological evidence of symptomless pulmonary tuberculosis never pass beyond the quiescent phase. Such individuals heal their disease over a matter of months or years.

During this period of quiescence many such cases are now discovered fortuitously by mass radiography. The problem then arises whether all should be given sanatorium treatment, combined with antibacterial drug therapy, as well as the benefit of resection should the site, character and extent of the disease be suitable, or should they only be observed. It is not known what percentage would not break down and would allow a normal life without treatment, nor which ones will break down.

Normally the army is not the place to observe such cases over years. Exceptionally, if a case is to be observed in the army he should be classified as "P.7 PES H.O." and followed up at the army or a civilian chest centre.

Cases may require to be observed for years, and although all efforts to isolate *M. tuberculosis* may fail, the individual may yet be capable of spreading his disease and be acting as a carrier. Such cases are particularly dangerous to young children. On the other hand, sanatorium régime, together with anti-bacterial drug therapy plus resection in suitably localized disease, has many advantages.

One view about so-called quiescent localized disease is that there is much more risk to the patient in leaving it alone and watching it than there is in removing it in these days of planned modern medical treatment combined with skilled thoracic surgery at the opportune time. Moreover, if resection in such cases fulfills all the hopes and aspirations expected of it, then the difference to the individual is far-reaching.

The Ministry of Health definition of quiescence is in urgent need of review. Absence of *M. tuberculosis* in stained films of sputum (without culture), however often they are repeated, cannot be regarded as indicating that the patient is definitely not infectious. In fact the definition is dangerous because it gives a false sense of security, particularly to those who have, or come into contact with, young children.

Furthermore I submit that any lesions capable of further retrogression are active. All such lesions contain live tubercle bacilli of varying degrees of virulence and at any time such lesions, the result of factors not understood, may act as a focal point from which the disease may spread by local extension, by bronchogenic spread and further aspiration, or by the blood stream.

It is repeated that the term "quiescent" gives a false sense of security to both patient and doctor. How often do medical reports state that "radiologically the lesion appears stable while from clinical and laboratory findings the disease appears quiescent." Such reports are a relic of the pre-streptomycin era when the best that could normally be hoped for was that the disease could be controlled sufficiently to allow the patient to earn his or her livelihood, but with constant reviews and periods of varying number and duration in and out of sanatoria, should his or her economic position permit.

To put the term "quiescence" in its true perspective would be to define it as "quietly *active*." Should that be so then all cases, however fortuitously they are discovered and however asymptomatic they may be, would all be referred for the opinion of a specialist, who not only fully appreciates the significance of these lesions but also knows the implications of the different medical categories.

These few words have been written in order to help medical officers in their disposal of cases regarded as having quiescent pulmonary tuberculosis, however "minimal" the lesion or lesions may appear.

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## THE EFFECT OF STRENUOUS EXERTION ON WOMEN

BY

D. H. RYDE, M.B., B.S.

*Formerly Captain, Royal Army Medical Corps*

MODERN woman is a far cry from her Neanderthal counterpart whose life depended upon her ability to jump, throw and run. In spite of her rigorous life, she bore her young and the world continued to grow. The huntress Atalanta, of Greek mythology, was so swift of foot she outran all suitors, till Milanion, with the help of Aphrodite, played her into his hands with three golden apples. (This is not the first case of fruit being the downfall of women.) Pausanias says that Greek women had their own Olympic Games, called *Heræa* after Hera,

wife of Zeus, consisting of foot races of 150 metres. It is said that Teuton women and English women in the fairs and wakes of the eighteenth century competed in foot races.

By nature of their structure and function women have to face certain disadvantages in games and these are now becoming more apparent. Various restrictions to activity have become accepted, often without foundation, the medical profession being partly responsible for this. A scientific outlook to these problems has been made so that we now have an enlightened approach to the effects of exertion and injury on emotions, menstruation and child-bearing. Various scientific papers have been published abroad, and in 1955 the American Amateur Athletic Union\* published a survey of the effects of sport on women, conducted by doctors, coaches and leading women athletes, all of whom had been connected with sport for many years. Whilst their conclusions are not necessarily correct, they form a basis for advice and a guide for research.

The first question, investigated by seventeen college doctors including a psychiatrist, was whether sport adversely affected the health of girls. Opinion was unanimous that muscular exercise was necessary for development, and failure to recognize this had been responsible for disabling maldevelopment in the past. Body-contact sports were found to be unnecessary. If girls had a pre-season medical examination and played games within their capacity, no harm would follow.

It is often said that competitive sports cause a degree of masculinity. Rather let it be said that those who are to an extent masculine will excel in sport. Coaches of women's teams complained of the continual loss of talent because of marriage and motherhood. The increasing number of beautiful girls who competed in the Olympic Games was also pointed out. Strangely, ballet, a largely feminine avocation, causes more muscular development than games, but ballet is a full-time profession.

From a survey of 35 active athletes, it was found that fertility and gestation were normal and pelvic measurements average. Labours were normal and perineal tears were no more frequent than usual. There was no increase in Cæsarian section and forceps delivery. In the cases recorded where pregnant athletes competed, nothing serious followed. Caution was expressed about horse-riding and high jumping in pregnancy; the only danger considered was malposition. There has been no record of harmful effects to the offspring. Naturally this series is not meant to be conclusive, but it is interesting.

It appears from another survey that 85 per cent. of women can compete during menstruation and perform to their usual standard. The rest may have increased pain or a profuse flow. It is also reported that dysmenorrhœa is often greatly relieved by vigorous exercise. In spite of these findings, it was suggested that for emotional reasons girls should refrain from competition. My own experience, and that of several experienced coaches, suggests that training can be continued safely during menstruation, and on important occasions girls should be encouraged to compete. This includes swimming.

---

\*A.A.U. *Study of Effect of Athletic Competition on Girls and Women*, Amateur Athletic Union, 233, Broadway, New York City.

The question of injury and permanent harm was examined most carefully. It appears that women are a little more accident-prone than men, especially in riding, hockey, basket-ball and track and field events, but their future health was not in jeopardy.

One of the first disciplines competitive sport imposes on women is control of the emotions and the acceptance of the thinking and living habits of good sportsmanship.

The article goes on to deal with the effects of games on delinquency, school work and personality in a favourable manner, but these findings are not specific for women.

Sport, like the arts, music and literature, is a means of self-expression. In many ways "Sport is an art, with the Olympic Games the concert stage of athletes who have reached the heights of sheer artistry in their chosen sport."

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## DERMOID CYST FORMATION FOLLOWING DERMAL GRAFT HERNIORRHAPHY

BY

Captain W. H. BEXON

*Royal Army Medical Corps*

AN implantation dermoid cyst is due to the implantation of an island of squamous cells into the subcutaneous tissues by a penetrating wound. Their vitality being unimpaired, these cells continue to grow until a cyst is formed, lined by squamous epithelium and containing degenerate keratinized debris and the products of such skin glands as are formed in the cyst wall.

Penetrating wounds of the type which give rise to cyst formation are quite common, but actual cyst formation is comparatively rare. The following case is of interest as an example of an implantation dermoid cyst following a "dermal graft" herniorrhaphy.

### CASE REPORT

Gunner A. H., aged 24, was admitted to a Military Hospital in Germany on 14th October, 1946, with an 18-month history of right inguinal hernia. On 18th October, 1946, herniorrhaphy was performed by a German civilian surgeon. The operation note was :

Incision : ellipse of skin excised from right inguinal region.

Findings : direct right inguinal hernia.

Procedure : ellipse of skin sutured to transversalis fascia and secured to posterior wall of inguinal canal. Routine closure of wound.

On 1st November, 1946, the patient was allowed to get up, and two weeks later he was discharged to a Convalescent Depot. He returned to his unit for duty on 4th December, 1946. At his release medical examination on 3rd October, 1947, the repair was found to be sound.

The patient was seen in the Surgical Out-patient Department at York on 20th September, 1952. The history he gave was that the hernia had recurred in December, 1947. On examination there was a swelling in his right inguinal region. A cough impulse was present in the swelling, but the swelling could not be reduced manually. A diagnosis of recurrent irreducible direct right inguinal hernia was made, and on 9th November, 1952, the patient was admitted to hospital for repeat herniorrhaphy.

Operation was performed on 10th November, 1952. The old scar was excised by an elliptical incision. The external oblique was divided in the direction of its fibres, and the spermatic cord was dislocated. The inguinal swelling was now found to be a cyst measuring 3 inches long by  $1\frac{1}{2}$  inches in diameter. This cyst was excised, thus exposing the posterior wall of the inguinal canal, and this was deficient so that a repair was considered necessary. A Bassini type of repair was carried out with interrupted nylon sutures, and a release incision was made in the anterior rectus sheath. The external oblique was repaired with catgut in front of the spermatic cord, and the skin incision was closed with silkworm gut sutures.

The cyst was now opened, and was found to be a dermoid cyst containing sebaceous debris and a large knot of matted hair.

Post-operative recovery was uneventful. The skin sutures were removed on 17th November, 1952, and the patient was discharged from hospital on 19th November, 1952, when the wound was well healed and the repair sound. He was seen again as an out-patient a month later. There was no discomfort in the wound, and the repair was sound and firm.

#### SUMMARY

A case is reported of a "dermal graft" herniorrhaphy which resulted in the formation of an implantation dermoid cyst, without the obliteration of the hernia. The dermoid cyst was excised and a Bassini type of repair carried out.

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### *Correspondence*

From COLONEL R. G. W. OLLERENSHAW, T.D.,  
ROYAL ARMY MEDICAL CORPS (T.A.)

#### *The Contribution of War to the Advancement of Surgery*

SIR,

Colonel Harold Edwards' Blackham Lecture, published in the October number of the *Royal Army Medical Corps Journal*, is one of the most stimulating papers we have had for some time, and it is with hesitation that I pick on a small historical inaccuracy. But the *Journal* will be quoted, and it is too easy for these things to be perpetuated.

Charles Bell, though he dealt with casualties from both battles, was present neither at Corunna nor at Waterloo. When in January, 1809, the news of the disaster of Corunna reached London, Bell offered his services to the Horse Guards and was sent down to the hospital at Haslar, where he operated on many of the disembarking casualties; his letters show that this is where he first became interested in gunshot injuries. From the outset his cases were admirably recorded, often with his own etchings. One of his drawings of this period, engraved by Thomas Landseer, survives in the third edition of *Anatomy of Expression*. It depicts the opisthotonic spasm of tetanus, and a footnote states that it is taken from soldiers wounded at the battle of Corunna. The original is, I believe, in the Royal College of Surgeons in Edinburgh.

Later, when the news came of Waterloo, Bell was in London, and said to his brother-in-law, John Shaw: "Johnnie, how can we let this pass? Here is such an occasion of seeing gunshot wounds come to our very door. Let us go." His letters tell how they forgot their papers and passed the customs, John Shaw brandishing surgical instruments in the faces of the officials. They reached Brussels on 29th June, eleven days after the battle, to find that the French wounded were still largely unattended, though the British medical services were in a slightly better way. Bell, whose one idea was to further his experience, offered at once to take charge of the French. He operated almost without a break for three days. One of the first letters he wrote on his return was to an M.P. acquaintance, protesting against the shocking hospital arrangements in Brussels, where there had been no preparation whatever for a battle which was inevitable. He addressed a further memorandum on the subject to the Duke of York, but it was to be many years yet before the medical services in the field were other than makeshift. Bell was ahead of his time.

May I say again how much I enjoyed Colonel Edwards' paper, and trust that my pedantry may be excused. The detail is part of the history of a fascinating life.

I am, etc.,

ROBERT OLLERENSHAW.

HEADQUARTERS (MEDICAL),  
42 (LANCS) INFANTRY DIVISION (T.A.),  
R.A.M.C. T.A. CENTRE,  
UPPER CHORLTON ROAD,  
MANCHESTER, 16.

#### REFERENCES

- BELL, C. (1870). *Letters*. London. J. Murray.  
OLLERENSHAW, R. (1951). *Med. Biol. Illust.* 1, 4.  
PICHOT, A. (1860). *Life and Letters of Sir Charles Bell*. London. R. Bentley.

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From CAPT. D. HOOKER, ROYAL ARMY MEDICAL CORPS.

#### *A Treatment for Athlete's Foot*

SIR,

With reference to my letter on the treatment of athlete's foot which was published in the April, 1956, number of the *Royal Army Medical Corps Journal*,

I would like to correct an error in the strength of formaldehyde used, which has been brought to my notice.

The strength of solution used should be 20 per cent. and not 40 per cent. as printed. Though the 40 per cent. strength was used by me originally with no local untoward reaction, I found it irritant to the eyes and nose of the person applying it. The 20 per cent. strength was equally effective to the feet without the unpleasant irritant effects to nose and eyes, and a more suitable solution for use by both medical orderlies or by patients themselves.

I am, etc.

D. HOOKER.

POOLE GENERAL HOSPITAL,  
POOLE,  
DORSET.

## Book Reviews

THE MEDICAL ANNUAL 1955. By Sir Henry Tidy, K.B.E., & R. Milnes Walker. Bristol: John Wright & Sons. 1955. Pp. 548+xliv. Plates 63. Illustrated. 32s. 6d.

It is impossible to do justice to this book in a review, since so many aspects of medicine and surgery are discussed by the eminent panel of contributors. Their authoritative opinions with references to recent and important literature are most valuable guides to the study of almost any subject one may care to choose.

The article on Epidemic Hæmorrhagic Fever by Lieut.-Colonel K. P. Brown, R.A.M.C., will be of particular interest to service medical officers. His description of this disease, new to physicians of the Western World, is masterly and his experience of it an illustration of the opportunities which may present themselves in the service. Military surgeons will find useful the sections discussing war wounds, particularly chest injuries, vascular surgery and head injuries. Summaries of the present status of many new drugs are an excellent feature.

J. P. B.

A MANUAL OF ANÆSTHETIC TECHNIQUES. By William J. Pryor, M.B., F.R.A.C.S., with a Foreword by J. H. T. Challis. Bristol: John Wright & Sons. April, 1956. Pp. 236+viii. Illustrated. 27s. 6d.

This book was written as a *vade-mecum* for junior anæsthetists to supply answers for day-to-day problems. On the whole it succeeds very well in this object and would prove a useful stand-by for the isolated and occasional anæsthetist such as may not infrequently occur in the army.



There are many inaccuracies in the text and drugs are usually called by their proprietary instead of their pharmacological names. The reader would also do well to remember that when specific doses are recommended these are probably for relatively fit or muscular patients and would have to be amended accordingly for the less muscular, *e.g.* "Injection of 2.5 mg. per stone body weight of Tubarine as an initial dose."

This is a good, handy, well bound and printed book, easily read and with an adequate index.

S. O. B.

**MEDICAL HISTORY OF THE SECOND WORLD WAR.** The Royal Naval Medical Services: Operations. Edited by J. L. S. Coulter. Vol. II. London: H.M.S.O. 1956. Pp. 543+xviii. Plates 19 and map. 57s. 6d.

The Second World War accentuated the tendency, already noted in the First, towards the disappearance of the clash of mighty fleets in decisive battle. The unspectacular, though vital, task which fell to the Royal Navy was that of keeping open the shipping lanes of the oceans for the passage of convoys of merchantmen. Against this background it is difficult to present a balanced narrative and the text of this volume tends to become a series of isolated incidents, some of which may strike the reader as trivial in relation to the outcome of a global war.

Early in the war it was decided, largely in the interests of morale, to provide a medical officer for each destroyer. This entailed finding accommodation, not only for medical staff, but also for medical stores and a sick-bay, a not inconsiderable task of internal reorganization.

Only those readers who do not appreciate the importance of firmly closed watertight doors at sea and are unfamiliar with the avidity with which the naval constructor seizes upon unoccupied space will be surprised that problems arose with regard to the collection of casualties. These difficulties, coupled with the danger of losing the entire medical potential from an unlucky hit should all the medical staff be concentrated in what appeared to be the safest part of the ship, led to a system of decentralization. At one end of the ship the medical officer established a Main Distributing Station, whilst at the other end the Senior Sick Berth Attendant established an Auxiliary Distributing Station. In addition a number of First Aid Posts were set up, each under a Sick Berth Attendant.

Some 45 pages are devoted to a daily journal of a medical officer afloat and about an equal number to lessons to be learned from it. The conclusion remains, however, that professional work occupied only a small part of the medical officer's day and the only real justification for his presence was in the interests of morale.

Much of the material dealing with medical events ashore is concerned with the Far East, where the Royal Navy suffered many grievous blows. Accounts of the brutality of the Japanese are only too painfully familiar. The Japanese medical service and, in particular, its preventive side comes in for much criticism.

It is difficult to understand why this should have deteriorated so much, for in the Russo-Japanese War of 1904 it was the equal of any existing medical service.

The medical stores and equipment for Operation "Torch" arouse some interesting speculations. Each port party, although provided with 1,000 condoms, had only 200 tablets of sulphaguanidine, and one can only hope that the standards of sanitation were so exemplary as to prevent dysentery completely.

The book is full of incident and makes exciting reading, but the student of medical history with limited time at his disposal is advised to concentrate on Volume I. As in the other volumes of this series, the index gives little help to anyone requiring a ready reference and is the feature most deserving of adverse criticism.

H. R. M.

THE FIFTH ANNUAL REPORT ON STRESS, 1955. Edited by Hans Seyle and Gunnar Heuser. New York : M. D. Publications Inc. Pp. 813. Illustrated. £6 11s.

This volume has maintained the high standard of previous volumes on this subject. It is an excellent reference book to the subject and contains an up-to-date bibliography.

Commencing with a synopsis of the concept of stress and reactions associated therewith it analyses the pathways through which stress stimuli are mediated and their effect on the various systems of the body. It contains an excellent chapter on Primary Aldosteronosis. It indicates the effects of stress on adrenocortical function and gives an interesting account of psychiatric stress in infancy.

This is a book which contains much biochemistry, physiology and pathology that is new and important and should be studied by all interested in the effects of stress on the individual.

J. T. R.

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### *Publications Received*

Index Catalogue of the Library of the Surgeon General's Office, U.S. Armed Forces Medical Library. U.S. Government Press. Pp. 1506+v. \$9.

Expert Committee on Drugs Liable to Produce Addiction. Sixth Report. W.H.O. Technical Report Series, No. 102. Pp. 21. 1s. 9d.

Psychiatry and Religion. M.D. International Symposia No. 3 New York : M.D. Publications Inc. Not priced.

THE ROYAL NORTHERN HOSPITAL, 1856-1956. By Eric C. O. Jewesbury, M.A., D.M., M.R.C.P., London : H. K. Lewis & Co. Pp. 157+xii. Illustrated. 17s. 6d.

- The Malaria Conference for the Western Pacific and S. E. Asia Regions (Second Asian Malaria Conference). W.H.O. Technical Report Series, No. 103. 1s. 9d.
- Expert Committee on Trachoma (Second Report). W.H.O. Technical Report Series, No. 106. Pp. 20. 1s. 9d.
- Expert Committee on Professional and Technical Education of Medical and Auxiliary Personnel (Third Report). W.H.O. Technical Report Series, No. 109. Pp. 19. 1s. 9d.
- The Training of Sanitary Engineers : Schools and Programmes in Europe and in the U.S. By Milivoj Petrik. Geneva 1956. (World Health Organization : Monograph Series, No. 32). Pp. 151. 20s.
- Expert Committee on Psychiatric Nursing. First Report. W.H.O. Technical Report Series, 1956, No. 105. Pp. 43. 1s. 9d.
- Joint F.A.O./W.H.O. Conference on Food Additives. Report. World Health Organization : Technical Report Series, No. 107. Pp. 14. 1s. 9d.
- Expert Committee on Biological Standardization. Ninth Report. W.H.O. Technical Report Series, No. 108. Pp. 20. 1s. 9d.
- Venereal Diseases. A Study of Existing Legislation. Offprint from Vol. 7, No. 2, of The International Digest of Health Legislation. W.H.O., Geneva. Pp. 44. 3s. 6d.
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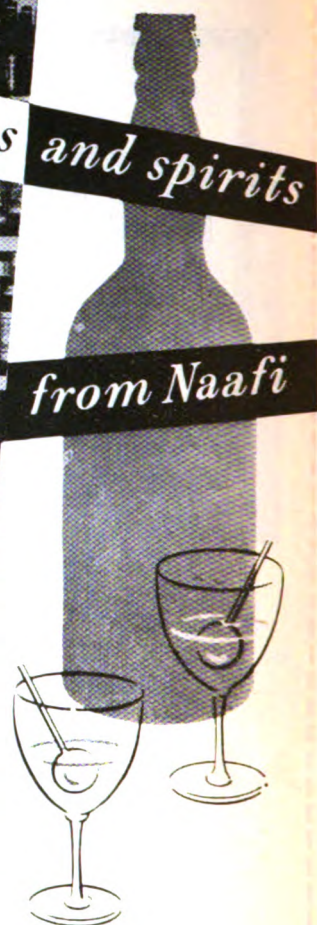
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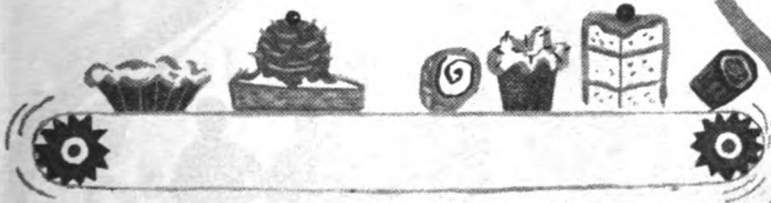
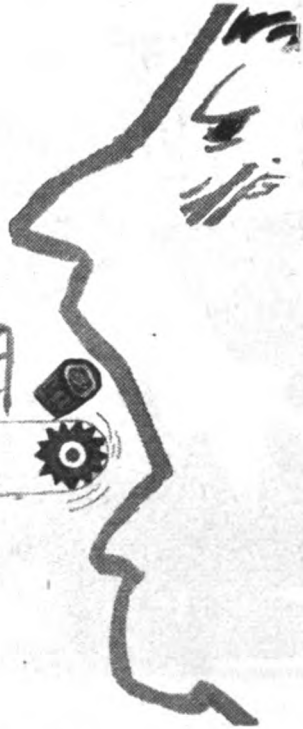
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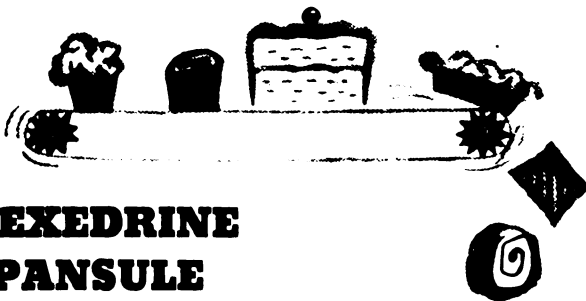
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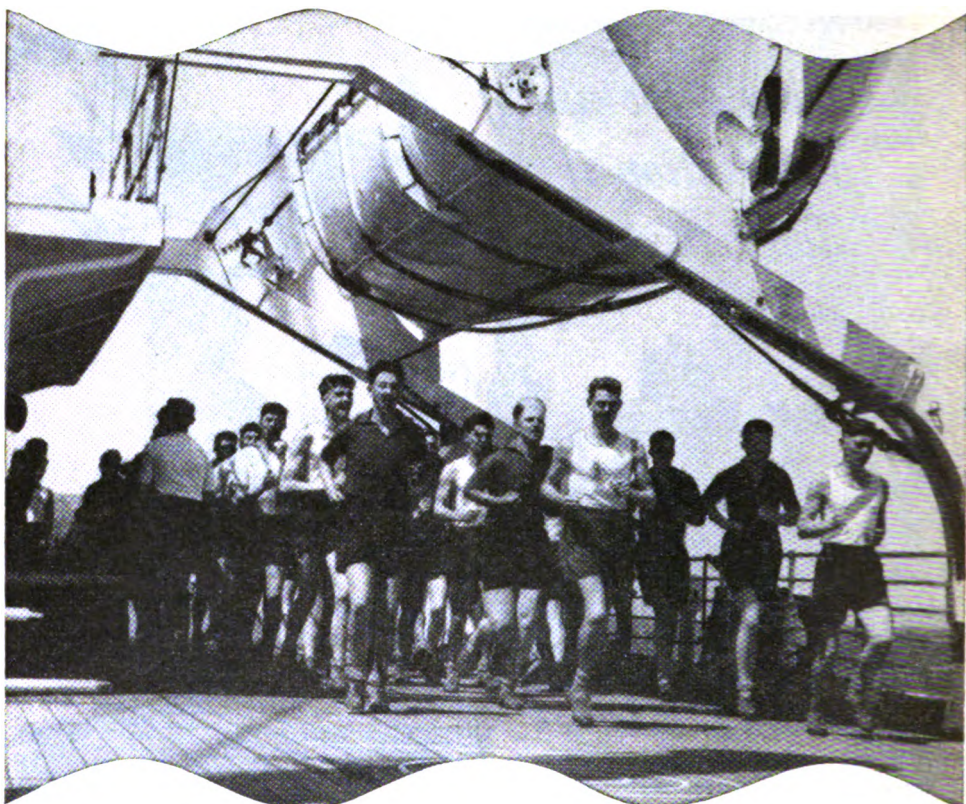


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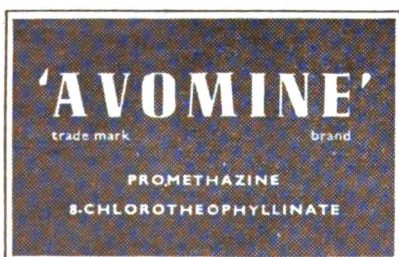
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## **SEXUAL DISORDERS AND MISCONDUCT IN SERVICE MALES**

BY

**Lieut.-Colonel HARRY POZNER, M.C., M.R.C.S., D.P.M.**

*Royal Army Medical Corps*

*Formerly Adviser in Psychiatry, H.Q., Northern Army Group*

SEXUAL abnormality in the male population has latterly been the subject of much inquiry and forthright public discussion. Its ætiology has been investigated in detail and attention has been drawn to the possible environmental influence of military service in the genesis of homosexual behaviour. For several obvious reasons there is very little authoritative or accurate information concerning the true extent of sexual disorder in the Services, and the relevant published literature is sparse. Loeser (1945) has studied 270 sexual psychopaths in the American army, and more recently Pearce (1954) published a short paper on the problems of sex in the British Services during World War II.

Those military personnel suffering from sexual disorder and voluntarily reporting on this account to their service doctors are comparatively few, and in general only seek advice for some ulterior motive or when threatened by disciplinary action resulting from previous anti-social or indiscreet sexual misbehaviour. That they represent only a small section of the sexual deviates in the Services is confirmed by police reports, sociological surveys and semi-documentary modern novels (Westwood, 1952; Kinsey, Pomeroy & Martin, 1948; Cory, 1951; Garland, 1953) indicating the active participation of service men of all ranks and social status in the homosexual underground of every large port and city.

Despite the more enlightened lay and professional attitude towards sexual disorder, many officers and men, acutely concerned with personal difficulties of this nature and genuinely desirous of advice, are reluctant to ask for help from their own medical officers. They continue to serve with diminishing efficiency, or in a few cases refer their problems to civilian consultants at their own expense. Some, humiliated and over-sensitive, hesitate to disclose their impotence or defective virility in a predominantly masculine environment where personal sexual prowess is always a ready and intriguing subject of discussion. Many distrust the youth and inexperience of their unit doctors and fear a breach of professional confidence. Others, with some justification, resent the fact that specialist reports concerning themselves are not always such confidential documents as they are presumed to be, and are liable to come to the notice of unauthorized persons. Finally there is the attitude of the patient who feels that once he has confided in his doctor-officer the matter automatically becomes official, that embarrassing or incriminating material is detailed in his personal documents, and that his military future may be adversely affected by the stigma of abnormality.

Whilst all types of sexual disorder occur in service men as in civilians, these disabilities are mainly concerned with the various manifestations of homosexuality. Stekel & Liveright (1927) were of the opinion that after World War I there was a marked increase of "genuine" homosexuality in war veterans, "an up-flaring of their homosexual components and a corresponding accentuation of their antagonism to woman." The same observation would appear to be true of the present post-war era. Westwood (1952) points out that at a very conservative estimate 4 per cent. of all males in the U.K. are completely homosexual and 13 per cent. have strong homosexual tendencies. It is further emphasized that for those age-groups in civilian life from which the bulk of service men is drawn the percentages of homosexually involved males are considerably higher. Press reports and court-martial publicity give a somewhat distorted view of the extent of sexual disorder in the Services, and it is apparent from even the most cursory of surveys that the incidence of known homosexuality in service personnel is considerably less than in civilians. From an investigation carried out in Northern Army Group, where information was obtained from several sources, it was found that the frequency of men known to be suffering from any form of sexual disorder was less than 1 per thousand (0.07 per cent.). The impression was also gained that there was more sexual disability amongst officers and less amongst other ranks than would seem at first evident from the available official data.

The records of 500 consecutive male service patients drawn from the British Occupation Forces in Germany and referred to the writer over a period of eighteen months for psychiatric opinion were examined for evidence of sexual disorder. Forty-seven men comprising 8 officers, 17 warrant officers and N.C.Os. and 22 other ranks had initially been sent for interview at their own request owing to sex difficulties, or for a medico-legal report following some military offence with a sex element. These cases excluded soldiers accused of rape or

indecent assault upon females, patients with acute anxiety or depressive symptoms resulting in diminished libido, and those individuals in whom psychosis or organic cerebral deterioration had given rise to uninhibited sexual misconduct. Also excluded from this selected group was a small class of patients in whom certain hysterical disabilities or skin conditions, including a few cases of intractable anal pruritus, indicated on examination a deep-seated homosexual conflict. Whilst it is appreciated that the conclusions drawn from a study of this group have little direct statistical validity, the findings are of some interest. Of the 47 males examined, 42 were volunteer regular personnel and only 5 were National Service men; 26 were unmarried bachelors, and 21 were or had been married.

The distribution by age groups was as follows, and indicated that the greatest incidence of sexual disorder amongst service males occurred in the third and fourth decades (Table 1).

Table 1

<i>Age in years</i>	<i>No. in group (47)</i>
Under 20 ... ..	7
20-25 ... ..	10
25-30 ... ..	13
30-35 ... ..	6
35-40 ... ..	7
Over 40 ... ..	4

The reasons for which these patients were referred for psychiatric opinion are given by general groups below (Table 2).

Table 2

<i>Group</i>	<i>No. in group (47)</i>
Homosexual behaviour with willing adult partners ...	15
Indecent assault on children or unwilling male adults ...	14
Exhibitionism and indecent exposure ... ..	7
Impotence ... ..	7
Transvestitism ... ..	2
Fetishism ... ..	1
Excessive masturbation ... ..	1

In most cases there was no difficulty in reaching a clear diagnosis (Table 3), but in a few instances where there was conflicting evidence of misconduct, disciplinary or marital threats, and alcoholism, there was considerable doubt as to whether the psychiatric disability claimed was genuine or simulated.

Table 3

<i>Diagnosis</i>	<i>No. in group (47)</i>
Psychopathic personality types :	
Emotional abnormality ... ..	3
Pathological sexuality ... ..	16
Paranoid schizophrenia ... ..	1
Endogenous depressive states ... ..	2
Anxiety states ... ..	4
Obsessive-compulsive states ... ..	1
Mental defect ... ..	1
Chronic alcoholism ... ..	4
No ascertainable mental or physical disability ... ..	15

It was noticeable that throughout the series of life histories of these subjects there frequently recurred similar constellations of ætiological and environmental factors. The commonest features were family disharmony, only children, dominating and possessive mothers, the death or loss of a father, seduction at an early age, a degree of personal inadequacy and occasionally a background in the home of religiosity or stern morality. During military service these influences were complicated by separation from a familiar circle, marital difficulties, boredom, alcohol, opportunity, isolation from a stable heterosexual social community, and not infrequently segregation in all-male groups in which there was already a small but established homosexual focus.

### IMPOTENCE

The impression gained from the clinical examination of service personnel is that impotence is the most distressing and humiliating of the male sexual disorders. This disability may be represented as a primary complaint or be elicited as a secondary symptom of physical or emotional disturbance. Patients express themselves in a variety of obscure or misleading ways, but fundamentally they complain either of a lack of or a diminished normal sexual desire, weak erections, sudden detumescence immediately prior to or at the moment of penetration, or most commonly premature ejaculation.

In the series under review, commissioned ranks predominated and fell into the 35-45 years age group, whereas the other ranks, including a large percentage of senior N.C.Os., were found between the ages of 25 to 30 years. All these patients were married and had, except in one case, fathered one or more children. They possessed remarkably similar personal characteristics. All of good intelligence and in some instances artistically gifted, they were ambitious, conscientious, and able without being in any way outstanding. It is interesting to note that without exception those patients in whom impotence was the presenting and disturbing symptom were employed in subordinate administrative and staff appointments without any real powers of command.

There was no case in which a physical causation could be clearly demonstrated, although in a few instances a transient sexual dysfunction followed some surgical procedure. The cycle of apprehension, inadequate sexual performance, humiliation and reinforced anxiety was a salient feature of every patient who did not respond initially to reassurance and simple explanation. The main symptom complexes associated with impotence were as follows :

- (1) Fatigue with physical, emotional or intellectual components.
- (2) Over-anticipation of physical reunion with wives from whom there had been a prolonged separation.
- (3) Specific sexual inhibitions towards the wife brought about by various psychopathological mechanisms which did not necessarily prevent the patient from obtaining full sexual gratification extra-maritally.

- (4) Guilt due to infidelity towards the wife, and fear of social or professional repercussions in the event of exposure.
- (5) Resentment in the frequent cases where there were sexual incompatibility or rejection of the patient for other reasons on the part of the wife.
- (6) Aggression in those cases where impotence was the resultant manifestation of some deep-seated sadistic criminality or a basic inadequacy with over-compensation.

Some knowledge of the management and treatment of a case of impotence should come within the clinical scope of every service medical officer. An essential first step is the full and careful examination of the patient with particular reference to the possible existence of endocrine dysfunction or neurological disease. It is rarely that any such disorder is found, but the negative result in itself is reassuring to the patient. At the first interview a detailed and unhurried history is taken, but it is stressed that nearly always in the beginning the sufferer tends to give a distorted or incomplete account of the development of his symptoms. It is only when his confidence has been gained after possibly two or more interviews that the true picture begins to emerge with a significant psychological background. With the establishment of a case of psychic impotence the doctor can adopt a more positive and encouraging approach. The occurrence of early morning erections, a history of previous satisfactory heterosexual relations, and the existence of temporary environmental or emotional stresses all indicate a relatively good prognosis. In some cases there is concealed guilt over masturbation persisting into adult life, and a frank and objective discussion of this and related problems will often produce immediately satisfactory results. With the patient's consent it is occasionally possible to discuss his difficulties with his wife, and her information, understanding and co-operation can prove invaluable.

The most successful therapy in the not too deeply complicated cases is a combination of common sense, careful investigation, a positive attitude towards cure, and the occasional resort to mild barbiturate sedation and the administration of male hormones either by mouth or by subcutaneous implantation.

#### INDECENT ASSAULT, INDECENT EXPOSURE AND EXHIBITIONISM

Criminal acts involving indecent assault, indecent exposure and varying degrees of exhibitionism comprised by far the largest group of sexual offences committed by service personnel brought to official notice. During the period covered by this survey there was, in over 50 per cent. of the incidents of this nature coming to the attention of the Special Investigation Branches of the Army and Royal Air Force, insufficient corroborative evidence to bring specific charges against individual suspects. Of the accused persons eventually brought to trial nearly all were referred for psychiatric examination.

Certain salient features emerging from the investigation constantly recurred. Indecent assault on soldiers and young male civilians was very frequently



associated with alcohol. Most of the incidents of exposure appeared to be unpremeditated, involved young children of both sexes, were fortuitous in nature and frequently took place, when the offender was married, in or near his family quarters. When faced with charges, the suspects invariably denied any criminal intent, and stated that they were the victims of either mistaken identity or misrepresentation, that their innocent actions were misinterpreted, or that they had no recollection of the relevant time due to transient "black-outs" or alcohol.

All these men revealed similar characteristics in their personalities and backgrounds. They were mostly regular senior N.C.Os., between 25 to 35 years of age, married and in a few cases with children of their own. They were all of average intelligence, not commonly given to habitual excessive drinking, leading quiet and comparatively steady lives. The married personnel frequently gave a history of marital difficulties, generally associated with sexual incompatibility between husband and wife and often due to the wife's distaste for physical intimacy or fear of pregnancy. If the offender was unmarried he usually gave a history of being an only child, of the loss of a father or of parental rejection at an early age, or of the loss of a fiancée by illness or accident in later years. In his service life there were added features of loneliness, social inadequacy and drinking for companionship.

On examination there was in the majority of patients little evidence of any gross psychiatric disturbance. Some exhibited anxiety or emotional tension arising from local and family stresses, and in a few there were features of pathological inadequacy. Contrary to general belief, obsessive-compulsive disorders were not apparent in any of the patients even in those few accused of frank exhibitionism. It was found that self-exposure often resulted in a slackening of sexual tension.

In a small group of cases it was considered that whatever the underlying mechanisms there was no obviously conscious intent to commit an offence. Predominating causal factors in the misconduct of the younger unmarried men and those living apart from their wives were fears of intercourse and venereal disease and the need for some demonstrative show of affection. In men of lower intelligence there was a naive outlook associated with limited worldly experience. The inadequacy of married men in normal sexual intercourse often led to attempts at sexual gratification at a more immature but potentially less humiliating level of conduct.

Specialist treatment for these offenders is not often considered necessary, but when recommended it is generally confined to psychotherapy and social reorientation. Advice in marital difficulties is helpful, and it is possible in the Services to reduce environmental stresses and the opportunities for misbehaviour by appropriate postings or change of employment.

From a medico-legal standpoint there is generally no psychiatric contra-indication to disciplinary action being taken against a proved offender. It has been found from experience that few service personnel ever indulge again in misconduct of this nature if they have been firmly dealt with for the first offence.



## TRANSVESTITISM, FETISHISM AND SADO-MASOCHISM

The importance of this group of sexual abnormalities in service men lies not in its numbers, which are comparatively few, but in the frequency with which it is associated with undesirable and sensational publicity.

Transvestitism, the wearing of clothes appropriate to the opposite sex, is not widespread in the Forces, but is more common than one would suppose from the incidents which come to official notice. In the writer's experience this phenomenon is seen equally amongst officers and men, but is more florid in the officer group. An individual in the privacy of his own quarters has been known to transform himself, with the help of cosmetics, wig, and a complete feminine wardrobe and accessories, into a passable imitation of an elegant and attractive woman. Barrack-room life does not lend itself to this type of masquerade, and the other rank transvestite is usually restricted to the furtive donning of exotic feminine underwear. It is mainly from this group that come those patients whose transvestite tendencies conflict with a very real fear of exposure and public ridicule. In no case of this nature investigated has there been evidence of any strong sexual gratification obtained from the practice, nor any obvious inclination towards overt homosexuality.

Certain ætiological factors were common to all the known transvestites. They were for the most part youngish bachelors with a sprinkling of recently but not very happily married men. Basic good intelligence was a group attribute, and each person was either an only child, an only son, or separated from his siblings by a significant difference in age. Dominating the background in every case there was a mother or mother-substitute, towards whom was exhibited invariably strong ambivalent feelings. The attitude of these men towards service life was surprisingly good, their efficiency usually high, and in most cases they apparently had no great difficulty in mixing on satisfactory terms with their comrades. It was only when they were prevented from indulging, without fear of detection, in their phantasies of feminine identification that they became frankly neurotic and reluctantly sought medical aid.

Transvestitism, except when it is associated with male prostitution or intent to defraud, is not in itself a recognized civil offence. Service amateur theatricals, particularly in isolated units and P.O.W. camps, permit the latent transvestite to indulge his inclinations with public approval and encouragement. In such cases it is more usual to find grotesque and comic female characterisations rather than those portrayals of simple feminine appeal which might offend or inflame virile masculine susceptibilities.

Although obviously undesirable, transvestitism is not incompatible with a useful service life. When, as a result of it, fear and frustration give rise to anxiety and obsessional preoccupation, medical action is necessary. A brief course of modified analytical therapy has, in a few cases, led to a satisfactory readjustment with retention in the Services in full employment. In the majority of cases it has been necessary to recommend medical invaliding from the Army on the grounds of unsuitable psychopathic personality traits.

Fetishism may be defined as a preoccupation with some article, usually inanimate and by itself inessential, but symbolic by association with an object of sexual desire. The fact that it exists in many varied and acceptable forms in the traditions of the Army would make an interesting thesis but one outside the scope of this paper. Fetishism is no crime unless it is accompanied by a criminal act. In the Army it most often comes to light in the apparently profitless theft of women's underclothing, in bizarre homosexual offences frequently involving civilians, and occasionally in unusual acts of larceny or sudden assault upon the person. A varied group of fetishes seen in military patients has included nearly every article of feminine apparel, polished boots, a fur coat, swagger canes, tresses of hair, rubber sheets, old socks, horse saddlery and cannon balls.

When reviewing a larger group of service fetishists than those included in the present survey it has been observed that they can be separated roughly into two main groups. There is the smaller group of other ranks, usually of regular N.C.O. status, married and possessed of inadequate, colourless personalities. Mediocrity is their outstanding characteristic. For them the fetish is probably the stimulus of an erotic imagery and the means of escape from a monotonous and dutiful marital and military regimentation. Bachelor officers, genuine or obligatory, form the second group. Generally of good intelligence, with some degree of culture, they are apt to be egocentric and hypercritical. Often regarded as amusing and harmless eccentrics by their colleagues, they are usually sensible enough to restrain their proclivities within law-abiding limits.

Fetishism in its more conscious sexual setting may cause the patient acute distress, particularly when sexual excitement becomes diverted from the fetish to the means by which it is obtained. Therapy on analytical lines with explanation and reassurance can do much to reinforce the patient's self-control. It has rarely been found necessary to recommend a discharge from the Services on psychiatric grounds. If, as may happen in a case of theft or assault, he is brought to trial he usually pleads that he is the unfortunate victim of an irresistible impulse. Such a defence can hardly ever be substantiated on psychiatric examination, and in these circumstances there is no valid contra-indication to trial or punishment. When there is evidence of genuine anxiety associated with the abnormality it is usual to recommend an attempt at treatment after all disciplinary proceedings have been concluded.

Sadism and masochism, the practices of deriving pleasure respectively from inflicting or being subjected to pain and humiliation, often coexist in the same individual and may be associated with sexual perversion in certain military offences. Sexual gratification is not the inevitable aim of sadism because in the Army there are ample opportunities for those whose egotism demands submissive recognition to express themselves in unmistakable though legitimate ways. Masochism is less prevalent, and its primary importance in service life is as a possible factor in those incidents where death has occurred in bizarre and apparently suicidal circumstances. Three cases of so-called inexplicable suicide have revealed on investigation that death was most probably

due to vaso-vagal shock or asphyxia arising by misadventure during the process of some complicated masochistic ritual. In other instances masochistic tendencies have proved to be the residual effects of extreme privation or punishment endured in P.O.W. camps.

Sadistic acts with an element of perverse sexuality often occur in improper associations between service men and civilians. Flagellation, deliberate sordid assault and acts of gross violence on provocation, leading in a few instances to murder, have all been reported. The factor of aggressive sadism is inherent in those offences where service men have been known to mutilate a woman's clothing or hair. From another aspect two cases have been reported to us of soldiers whose pyromania was associated with temporary relief from sexual tension.

The ætiological factors in the life histories of these offenders follow the pattern found in other sexual deviations, but it has been noticed that sado-masochism occurs with a significant frequency in personnel of Eurasian antecedents. Masochists tend to exhibit schizoid and obsessional personality traits, whereas sadists are usually more obviously psychopathic in an aggressive and anti-social manner. So far from being virile, many of the men in this group are undersexed, and this is a factor of some importance in certain cases of sadism where a progressively greater degree of violence has to be exercised to obtain sexual gratification.

Most of these offenders are genuinely psychologically disturbed. Because treatment is often custodial, therapy unduly prolonged and the results unpredictable, the main function of the law is to protect society. In the Army the aggressive and psychopathic sadist may be capable of restricted employment in total war, but on general principles his retention in any unit is undesirable. His presence is corrosive to good morale, and it is recognized that any sadist with a history of violence is a potential murderer.

### UNDINISM, COPROLALIA AND PORNOGRAPHY

Undinism, an abnormal interest in urine or urination, coprolalia, excessive swearing with frequent references to the bodily excretions, and pornography, the expression of obscenity, occur frequently in association with sexual abnormality. Psychiatrists are occasionally asked to examine service men who have been apprehended by the civil police for loitering in public urinals. During the last twelve months we have reported on three soldiers who drank urine when engaging in other acts of perversion. Behaviour of this type can only really be satisfactorily explained in terms of analytical psychopathology, and the individuals concerned are to be regarded as immature psychopaths with fixations at more primitive levels of psychosexual development. Long-term therapy is impracticable under service conditions, and these offenders should be separated from the Army by administrative or medical means.

Pornographic expression in its various forms is a recognized and understandable feature of military life. When it becomes part of an obsessional

pattern of behaviour it is liable to result in criminal acts. In this connection we have interviewed soldiers admitting to making offensive and distressing telephone calls to female personnel, a chief clerk who typed away industriously for days at a book-length erotic odyssey, and an officer who, under a pseudonym, wrote an extraordinary series of obscene letters for distribution to a select circle of subscribers. The contrast, as always, appears between the private and professional lives of these individuals. They are mostly known to their associates as quiet and efficient workers, and as dutiful sons and husbands and benevolent fathers. Their acts arise from psychological immaturity, and Clifford Allen (1949) suggests that these and allied patterns of behaviour can be labelled as "perversion-fetishes." Medical disposal depends on the individual case, but in the more florid instances the service prognosis is poor, and there is usually no psychiatric contra-indication to disciplinary action when a definite charge can be brought.

### HOMOSEXUALITY

For the purposes of this paper the definition of homosexuality has been restricted to homosexual physical contact between consenting males. In the group under discussion it is concerned mainly with sodomy, which in a little more than 30 per cent. of all the cases of sexual abnormality was the presenting reason for psychiatric referral. The offenders fell roughly into two distinct age groups. Between the ages of 18 to 20 years were found the immature and sexually psychopathic young soldiers, and in the group of 25 to 40 years there were the confirmed and habitual officer and other rank perverts. In each case regulars significantly outnumbered the National Service men.

A widespread investigation by military psychiatrists into the nature of this problem in the Army revealed that four major groups of homosexuals could be distinguished :

- (1) The essential or true homosexual who by sub-limiting his tendencies managed to live a chaste life, but who occasionally was prone to acute anxiety if exposed to constant temptation or a strong physical attraction.
- (2) The essential homosexual who had no moral objection to indulging in his activities with other service men but who preferred a more permanent association.
- (3) The promiscuous male prostitute whose homosexuality was either essential or acquired and who profited from his abnormality, and constituted a serious menace to unit morale.
- (4) The active opportunist, bisexual or immature heterosexual, who for various reasons engaged in casual homosexuality. In this group were included the more vicious perverts who had no hesitation in corrupting suggestible young soldiers of weak character.

From the available information it has been concluded that very few National Service men are permanently affected by a subjective homosexual experience

during military service. On being removed from undesirable influences they quickly revert to a stable and satisfying heterosexuality. The young soldier seems to be sexually most vulnerable during the first few months of his training. Confined to barracks and impersonally regimented, he may have difficulty in adjusting himself to a frequently new and disturbingly less inhibited form of communal existence. If exposed to homosexual suggestion from somebody who can apparently help him to settle down he may disregard moral scruples for the sake of his personal convenience. Those who do succumb to this sort of persuasion are recruits with either pre-service abnormal tendencies, or are of low intelligence and immature emotions, tending to drift aimlessly through their lives without any strong moral or social sheet-anchors.

In the Services confirmed homosexuals tend to congregate in certain units or localities, and it is suspected that such cliques are created by design rather than by the accidents of posting. In these situations the dominant character is nearly always a long-established pervert of some seniority and local influence. He has usually managed to find employment for himself so that whilst he continues to carry out his military duties adequately, he remains free from rigid supervision and is given a comparatively free hand in dealing with subordinates. Surprisingly enough, when unpleasant revelations ultimately oblige his unit to initiate drastic disciplinary action, it is often disclosed that, although he has long been regarded by superiors and others outside his circle as sexually abnormal, no attempt has been made to warn him or curb his activities in the Army.

A special committee of the Council of the British Medical Association in a recent pamphlet (1955) recognized two groups of homosexuals: (1) The essential type in which homosexuality was determined possibly by genetic or endocrinological factors and more probably by environmental influences in very early life; (2) the acquired type in which new factors arising in later childhood, adolescence or adult life were predominant. From a service standpoint acquired homosexuality, with its possibilities of control and prevention, merits most attention. Nearly always significant in the ætiological factors are the following: (1) A disturbed early background as in the case of an only child with a possessive widowed mother. (2) Seduction at an early impressionable age. (3) Persistence of adolescent sexuality into adult life. (4) Segregation in male communities, e.g. the Services, penal institutions, P.O.W. camps. (5) Fears of venereal disease or the responsibilities of heterosexual liaisons and marriage. (6) Curiosity or a tendency to depravity in the bored sensation-seeking individual. (7) Alcoholic intemperance tending to break down inhibitions, blunt the appreciation of moral values and allow the individual to indulge in homosexual gestures under the guise of good fellowship.

The most common diagnostic finding in confirmed service homosexuals is a basic personality disorder, although homosexual behaviour is frequently observed in subjects without any ascertainable evidence of significant psychiatric disability. The correct diagnosis is of importance in determining the methods of control and disposal. Unfortunately the attitude towards service homosexuals is not uncommonly prejudiced by subjective emotional factors which may lead

to an over-aggressive or in some cases to a surprisingly lenient approach. Psychological and physiological factors influencing homosexual behaviour are of undoubted importance, but they are occasionally over-emphasized at the expense of the principles of self-discipline and personal responsibility. The crux of the matter seems to be summed up in an extract from a confidential report by the Church of England Moral Welfare Council (1955) on homosexuality :

“Where inversion is the settled condition of a person (innate or acquired) it will be important to make a very clear distinction between this condition (which is morally neutral) and the invert’s homosexual practices, which are within the range of choice and to which moral categories therefore apply.”

Whilst it is possible in special circumstances for a confirmed homosexual to be retained in the Army, such a course should only be taken when retention is of benefit to the Service. Promotion and wider responsibilities, if compromised by homosexual indiscretions, increase the possibilities of blackmail and divided loyalties, and constitute a potential threat to service security. When the conservation of manpower was an essential priority it was often considered practical and realistic to post known homosexuals of good intelligence and proved ability to large towns, where their private indulgences were less likely to be inimical to the best interests of their Service. Nowadays such considerations are of less moment. The normally chaste homosexual who has momentarily yielded to the urgency of a drive, which most of his life he has repudiated, can with sympathetic, skilled assistance be returned to full and profitable military employment. The danger lies in the possible loss of self-confidence in his ability to resist further similar stresses. On reflection he may feel that the heart-searchings and spiritual torments to which he has voluntarily subjected himself are inadequate compensation for a lonely and emotionally sterile future. Constantly guarded in his social relationships, he is at a permanent disadvantage in a predominantly male community.

#### THE LAW, PUNISHMENT AND HOMOSEXUAL OFFENCES

It has become almost customary for a soldier charged with sexual misconduct to be referred for a psychiatric report irrespective of whether or not he exhibits any features of mental illness. The request for this examination may come either from the prisoner, who has belatedly volunteered to undergo treatment for an abnormality of which often he has previously never complained, from the prosecution with the idea of refuting any suggestion of diminished responsibility on the part of the accused, or from the defence which will snatch at any shred of medical endorsement to patch up a threadbare plea of mitigation. The relevant portions of the psychiatric disciplinary report available to opposing counsel are frequently misleadingly brief and uninformative. When called upon in open court to give expert testimony, the psychiatrist, who considers himself to be impartial and acting in good faith, may be asked to reply to categorical questions to which there are no generally accepted right answers but only expressions of personal opinion. Objective and knowledgeable evidence can be of great value

to the court, but it is considered from experience that the request for a psychiatric report should come only from the court after a preliminary hearing of the case. In this way the members would have the opportunity of discussing his conclusions and if necessary of calling before them in private the psychiatrist to clarify or enlarge upon any points of importance or interest. Certain fundamental questions are always asked and an attempt is made below to give the substance of the usually accepted answers.

*1. Is the accused suffering from any psychiatric illness which might have influenced his behaviour ?*

In a large number of cases no psychiatric disability severe enough in degree to warrant a specific diagnosis can be found. Alcoholism, mental dullness, ignorance, temporary amnesia and neurosis of short duration carry little weight in law. The psychopathic personality with its concept of impulsive, short-term self-gratification, is a difficult one to impress upon a lay audience, and usually only strengthens its conviction that society must be firmly protected from the person on trial.

*2. Does the accused require special treatment, and can he be cured ?*

Essential homosexuality is an irreversible condition and a permanent cure is unlikely. The most that can be expected is that the true invert with skilled support can exercise sufficient self-discipline to prevent himself from committing overt anti-social acts. In acquired homosexuality the prognosis is theoretically better, provided the full co-operation of the patient is assured and adequate facilities for treatment are made available. Treatment is only likely to succeed in carefully selected individuals, and Sessions Hodge (1950) states: "The old, the adjusted, the feminine and those with strong tendencies are for the most part beyond the reach of complete cure at the present state of psychological knowledge."

A strong and sincere wish to be cured is a prerequisite for all forms of therapy, but it does not necessarily lead to a successful outcome. It is known that many offenders who request treatment only do so to avoid possible imprisonment, and have no genuine intention of desisting from their activities once the threat to their liberty has passed. The effectiveness of treatment is ultimately dependent upon the intelligence, good will, adaptability and relatively intact personality of the patient.

*3. What forms of treatment are available ?*

An eclectic brand of analytical psychotherapy is often of considerable value in selected cases. Superficial psychotherapy of a more direct and realistic nature can be used in association with an attempt to manipulate the environment of the patient. Oestrogens such as stilbœstrol can be employed as a temporary measure to tide over a difficult period in a homosexual with reactive anxiety, but they have no permanent value in suppressing sexual desire. Castration has little scientific justification and is applicable only to a very few incorrigible



offenders. Service patients who require prolonged intensive treatment likely to interfere with their military activities are medically unsuitable for retention in the Army.

**4. *Will punishment have any effect on the prisoner?***

It is often noticed at courts-martial that there is an apparent difficulty in distinguishing between punishment and imprisonment. In the vast majority of cases where a homosexual offence has been deliberately committed in full awareness of its socially unacceptable nature no sensible psychiatrist will deny the necessity for punishment. Unfortunately there are some unusual discrepancies in the types of punishment awarded. It sometimes appears that extraordinary leniency is shown for reasons other than medical, whereas in certain cases in which the medical considerations are important and relevant, unduly heavy prison sentences are imposed. For vicious perverts and persistent offenders imprisonment is the only practical answer under present-day conditions. For the young, unsophisticated and impressionable first offender it seems illogical to segregate him in a male community where there are most probably degrading criminal and predatory influences. The general opinion is that if a homosexual is sent to prison he should be carefully supervised, the length of his sentence should be related to his psychiatric assessment, long enough to be effective and capable of being reviewed in the light of his response to any available treatment.

**5. *Will a prisoner receive any treatment in a military corrective establishment?***

The facilities for treating confirmed homosexuals in military custody are for various reasons quite inadequate. This is not unreasonable if the view is accepted that the Army is not the place to treat social aberrants. In civilian prisons the prospects of treatment are definitely better, but there is considerable room for improvement, and it has become obvious that psychopathic homosexuals must eventually be treated in specialized colonies.

**6. *Is the prisoner liable to commit similar offences after punishment?***

In some cases it is possible for the psychiatrist to affirm with reasonable confidence that the prisoner under consideration will commit no further homosexual offences. But he should not be placed in the invidious position of guaranteeing another person's future good behaviour. Loeser (1945) points out: "There is nothing about the homosexual drive which deprives the sufferer of ability to restrain his sexual actions." There are many homosexuals who regard themselves as members of a privileged group, endowed by circumstances beyond their control with instincts which, despite public disapproval, they consider to be normal. They see no convincing reason for accepting heterosexual standards. The threat of public exposure and punishment may cause them to avoid a conspicuous indiscretion, but they will certainly continue to exercise in private their choice of sexual activity.

## THE PREVENTION OF SEXUAL DISORDER IN THE SERVICES

A recruit with a homosexual orientation is a potential vector of sexual abnormality in the Army and requires more than a purely passive or disciplinary attitude on the part of those in authority. Much can be done to rectify what is largely a disorder of human relationships. This is an essential part of early military training when it is possible to indoctrinate the principles of self-reliance, personal discipline and the obligations of the individual to the group. An impersonal authoritarian approach is not enough, and all ranks who are responsible for dealing with recruits should be carefully selected for their qualities of leadership, strength of character and personal integrity. Because a high morale militates against social degeneracy, any measures which tend to raise the status of the soldier and emphasize his service loyalties should be employed to the full. A sincere religious belief is often effective against homosexual temptation, and from this aspect the assistance of wise and experienced chaplains with a true sense of vocation is invaluable. Confirmed homosexuals whose rehabilitation is unlikely should be removed from the Army by the most expeditious and appropriate means. Any soldier who feels he has cause to worry over apparently abnormal tendencies should be able to see his medical officer with the reassurance that any disclosures he may make will be regarded as confidential and will not lead to disciplinary repercussions.

The attitude of public opinion towards sexual abnormality has in the past undergone many changes and even in these days is inconsistent owing to widely varying cultural, religious and economic factors. The only safe and logical conclusion that one can draw from history is that in any nation the incidence of homosexuality is directly related to its vicissitudes in world affairs. Sound and acceptable moral standards are implicit in the structure of an influential and progressive civilization. At this time when there are many factors in modern life tending to depreciate the finer human values, the fighting services are important custodians of the nation's youth, and their efforts to combat any threat to a moral society must have far-reaching results in larger spheres.

## SUMMARY

1. In a series of 500 consecutive male personnel referred to a military psychiatrist, 47 were examined for sexual disorder or misconduct. The incidence of sexual abnormality in the Services is considered to be greater than that which comes to official notice, but is significantly less than that estimated in corresponding age groups in civil life. There is no indication that a service environment tends to corrupt the average type of emotionally stable recruit in the absence of any pre-service homosexual orientation.

2. The incidence, nature and management of sexual impotence in service males is discussed in relation to available treatment.

3. Sexual misconduct in its most frequent forms in service offences is considered with reference to ætiology and the disposal of the offenders. Brief

mention is made of the mechanism and manifestations of other reported sexual perversions and abnormalities.

4. The ætiology and implications of essential and acquired homosexuality are discussed. The essential homosexual is at a permanent disadvantage in any fighting service. Rehabilitation of the acquired homosexual depends on his environment, psychological maturity, good will, strength of character and personal integrity. The medico-legal aspects of homosexual offences in soldiers are considered with reference to the merits of treatment and punishment.

5. Prevention of homosexuality in the Army is briefly mentioned with emphasis on early recognition, correct management, and desirable influences.

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# MEMBRANE FILTERS IN BACTERIOLOGY

BY

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## INTRODUCTION

GOETZ and Tseuneishi (1951) have described the principle of filtration of bacteria on to molecular filter membranes and have shown how this has been applied to the quick screening of large quantities of water for the purpose of assessing its potability by bacterial count. These authors have made a study of such membranes which were especially favoured in Germany, and perfected an apparatus using such filters which is now largely used in waterworks and elsewhere.

## METHODS

Briefly, the technique is to filter water through a membrane containing about 500 million fine openings in the filtration area, these pores being narrower on the inlet side of the membrane than on the outlet side (anisomorphous). The membrane is supported on a Seitz-type filter and instead of the usual Seitz pad, a sintered glass support is used. 1,000-1,200 ml. of water per minute can be filtered through at a vacuum of 23-30 in. of mercury (we found 20 in. sufficient). Nutrient material containing peptone M.49, sodium chloride 0.25 g., lactose 0.5 g., yeast extract 0.6 ml., distilled water to 100 ml., is coarse-filtered into a petri dish containing a pad of blotting-paper capable of absorbing 2 ml. of nutrient solution. After use, the membrane is placed on this pad, nutrient material diffuses through the pores from the lower surface and bacterial colonies grow out from the cells on the upper surface, after a few hours' incubation in a moist atmosphere. A standard grid pattern can be imprinted on the filter disc for ease in counting. The filter is about 50 mm. in diameter and 150 $\mu$  thick. Filters are sold in packs already sterilized and the apparatus is sterilized in the autoclave in the usual way.

It was felt that apart from water examination, this method might be convenient for clinical and epidemiological investigations. It was therefore decided to try it on a range of organisms. Although the American membranes can be sterilized and re-used, the apparatus is costly. However, a German-made "membran filter" is equally effective and is cheap, although it can be used only once. This latter filter was used in this study.\*

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\* Packed by Hudes Merchandising Corporation Ltd., 52, Gloucester Place, London, W.1. One hundred membranes and mats with import duty cost £7. Prices for larger quantities would be proportionately less.

A special glass suction apparatus is supplied with the German filter membranes, as a Seitz type of filter is not suitable because the fittings damage the delicate membrane. A Seitz pad, however, was found suitable in the place of the blotting-paper. The organisms used in the experiments were *Streptococcus pyogenes* and *Streptococcus viridans*, *Pneumococcus*, *Salmonella typhi* strain Ty2, *Salmonella paratyphi A*, *B* and *C*, *Corynebacterium diphtheriae mitis* type, *Haemophilus pertussis*, *Clostridium welchii*, *Neisseria meningitidis*, *Brucella abortus* and *Mycobacterium tuberculosis*. *Bacterium coli* was used as a control.

All organisms tested were first passed through the filter in water containing an estimated average of about 50 organisms in 100 ml. Viability was checked at the same time by a modified Miles and Misra technique. Organisms which grew more slowly on the membrane than by routine methods, or which fell short of the expected number of colonies estimated by the Miles and Misra count, were not considered suitable for this type of culture and we did not proceed with them. Those that gave sufficiently satisfactory results as shown by speed of growth and good colonial yield were then tested again in the various natural sources from which one might require to isolate them, *e.g.* urine, throat swabs, etc.

In the earlier experiments, even where satisfactory growth occurred, the lack of colour of the colonies on the membrane robbed them of much of their characteristics as judged by culture on the usual media. It was therefore decided to incubate the membrane directly on solid media, thus replacing the filter pad and liquid medium. Provided the plate was reasonably damp it was anticipated that the medium would diffuse just as easily through the membrane. This, in fact, occurred and, using *Salm. typhi* and Wilson and Blair medium, typical black colonies appeared on the upper surface of the membrane. This method was followed throughout the rest of the trial and constitutes a departure from the original procedure.

## RESULTS

The results are outlined below and the colonial appearances can be seen in Plates I and II.

*Bacterium coli*. This was the original organism used in membrane filter culture and therefore was tried first to serve as a control for our technique. It was grown in nutrient broth for eighteen hours and a one in a million dilution prepared in sterilized tap water. From this dilution, 5 drops from a pipette delivering 50 drops per ml. were added to 100 ml. of sterilized tap water. This dilution, after mixing, was drawn through the filtration apparatus and followed by a further 100 ml. of sterile water to wash the apparatus free of any remaining organisms. The filter was then removed aseptically and placed on a sterile Seitz filter pad impregnated with the liquid culture medium. Incubation was carried out in a moist chamber at 37° C. and the pad examined for growth after six hours and again after eighteen hours. No growth was visible after six hours. Fig. 1 (Plate I) shows the appearance after eighteen hours. Miles and

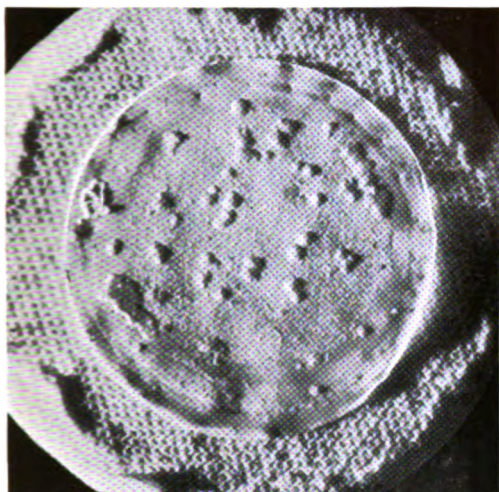


Fig. 1. *Bacterium coli*.

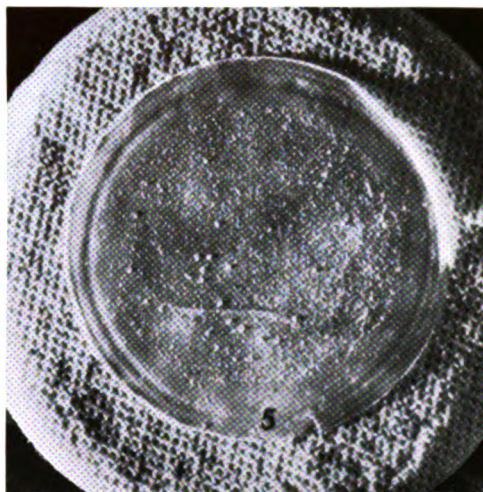


Fig. 2. *Streptococcus pyogenes*  
(Lancefield Grp. A).



Fig. 3. *Salmonella typhi* (strain Ty2).

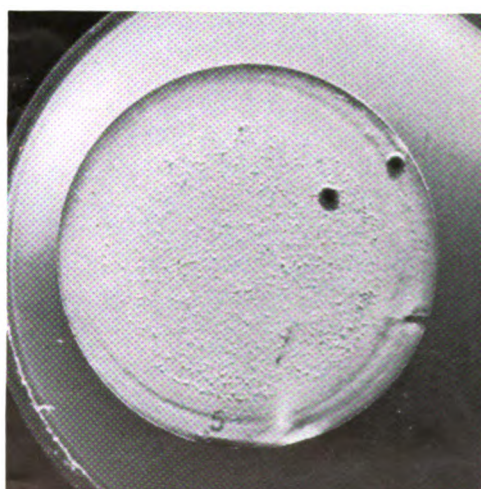


Fig. 4. *Salmonella paratyphi* A.

PLATE I



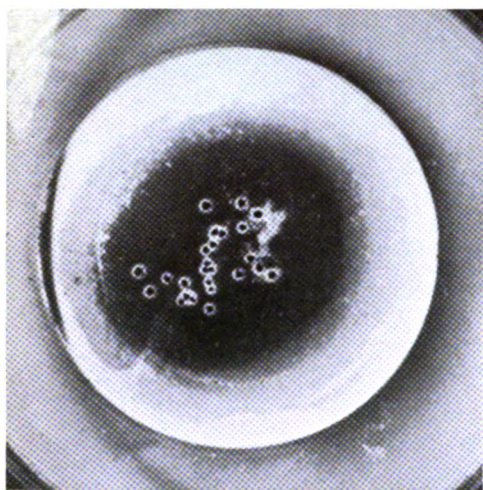


Fig. 5. *Salmonella paratyphi* B.

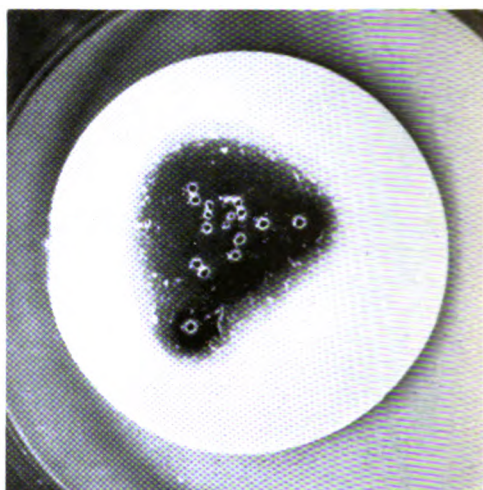


Fig. 6. *Salmonella paratyphi* C.

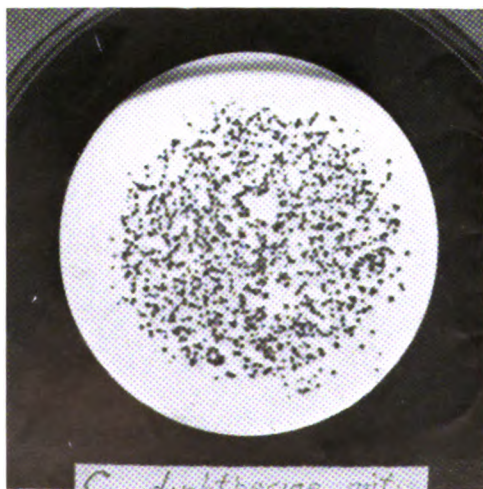


Fig. 7. *Corynebacterium diphtheriae* (mitis type)

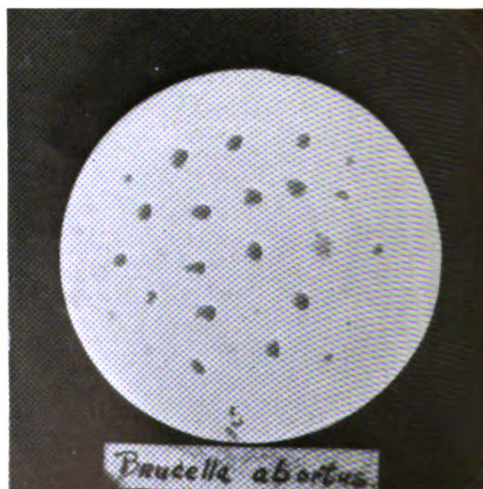


Fig. 8. *Brucella abortus*.

PLATE II



Misra counts performed at the same time as the main experiment showed the original one in a million dilution to have a viable count of 8 colonies per drop (using the 50 drops per ml. pipette). Therefore 5 drops of this dilution would have been equivalent to 40 viable organisms. The filter pad actually shows 45 colonies (together with a small amount of debris removed from the water).

*Streptococcus pyogenes*. The organism was grown in serum broth for six hours. Using the same method as before, the equivalent of 30 viable organisms was added to 100 ml. of water and passed through the filter. The liquid medium in which the Seitz pad was soaked was in this case serum glucose broth. In seventeen hours, 26 colonies appeared—these were smaller than those seen by ordinary methods (see Fig. 2). No obvious advantage would appear to exist over routine methods for this organism. Repeating the experiment with 15 organisms per 100 ml. and thereafter lowering the Seitz pad on to blood agar, 10 colonies appeared and a zone of hæmolysis was seen.

*Streptococcus viridans*. The same methods were used for this organism, but no growth occurred.

*Pneumococcus*. The organism was grown for eighteen hours in serum glucose broth: 70 organisms in 100 ml. water, were passed through the filter and the membrane cultured on a Seitz pad, impregnated with serum glucose broth. Only 14 colonies appeared. No growth occurred if the pad was placed on blood-agar. The result for this organism was therefore unsatisfactory.

*Salmonella typhi* strain Ty2. The organism was grown in nutrient broth for eighteen hours: 28 viable organisms in 100 ml. water were passed through the filter and the membrane cultured on a Seitz pad impregnated with nutrient broth. A confluent growth resulted and the experiment was unsatisfactory.

The experiment was repeated dispensing with the Seitz pad used for soaking up the liquid medium. Immediately after filtration the membrane was lowered by aseptic technique on to a slightly damp Wilson and Blair plate and incubated in a moist atmosphere at 37° C. for eighteen hours. The results shown in Fig. 3 are very satisfactory although growth is slightly confluent. Typical black colonies with a metallic sheen are seen on the surface of the disc. This method was used throughout the remaining experiments.

*Salmonella paratyphi A*. The organism was grown in nutrient broth for eighteen hours and a one in a million dilution was then prepared in sterilized tap water. From this dilution, 2 drops (from a pipette delivering 50 drops per ml.) were transferred to 100 ml. of sterilized tap water, and after thorough mixing, this dilution was drawn through the filtration apparatus and followed by a further 100 ml. of sterile water to flush through the filter apparatus. The filter membrane was then removed aseptically from the apparatus and placed in contact with the wet surface of a freshly prepared Wilson and Blair plate. A piece of moist filter paper was placed in the lid of the petri dish (to produce a moist atmosphere) and the plate was then incubated in the normal way for twenty-four hours. Viable counts carried out on the initial one in a million dilution averaged 9 colonies per 1/50 ml. drop. Therefore two drops of this

dilution would have been equal to 18 viable organisms in the 100 ml. of water filtered. Fig. 4 shows two large colonies developed on the membrane.

*Salmonella paratyphi B*. The procedure was repeated as for *Salm. paratyphi A*, but 44 viable organisms per 100 ml. were passed through the filter (4 drops of a suspension containing 550 organisms per ml.). Fig. 5 (Plate II) shows 30 colonies were obtained as opposed to the 44 colonies suggested by the viable count. There was no confluence but the black colour tended to run out of the sides of the colonies and diffuse into the medium. The colonies were, however, distinct, showing black centres and paler peripheries.

*Salmonella paratyphi C*. The method was the same as for *Salm. paratyphi A* and *B*: 20 viable organisms were filtered through and 19 colonies resulted. These were identical in appearance with *Salm. paratyphi B* (Fig. 6).

*Corynebacterium diphtheriae mitis* type. The organism was grown for eighteen hours on blood-agar plates and a suspension prepared by washing off the resultant growth was then diluted 1 in 100,000 in sterile tap water. Viable counts gave a figure of 370 organisms per ml. at this dilution. One ml. of this dilution was taken into 100 ml. of sterile tap water to wash through the filtering apparatus. The membrane was then removed by sterile technique and placed in contact with the wet surface of a blood-agar plate containing potassium tellurite. Incubation was carried out in a moist chamber at 37° C. for forty-eight hours (some growth had occurred after twenty-four hours, but the colonies were only pin-point in size). The viable count figure suggested that 1 ml. of the 1 in 100,000 dilution contained approximately 400 viable organisms. Fig. 7 shows the result obtained after forty-eight hours' incubation. The growth was substantial and characteristic.

The reason for passing a larger number of organisms through the filter was that a 50 organism quotient does not always produce a growth even by ordinary methods, but probably a figure of about 50 would have grown satisfactorily in this case. A repetition of the experiment with Hoyle's medium gave equally good results, except that a full forty-eight hours was required for visible growth. Repetition using greatly reduced numbers of organisms produced results in excess of those to be expected by the Miles and Misra counts.

*Brucella abortus*. This organism was cultured for four days on liver infusion agar plates and washed off with sterile tap water. A suspension was then prepared of approximately 1,500 million organisms per ml. (Brown's standard opacity tube reading.) This suspension was diluted one in a million in sterile tap water, yielding approximately 1,500 organisms per ml. Assuming the viable count to be 60 per cent. it would have contained 6/10 of 1,500 organisms per ml.—i.e. 900. 0.1 ml of this dilution, representing 90 organisms, was taken into 100 ml. of sterile tap water, mixed and passed through the filter. At the same time viable counts were performed from the original one in a million dilution. The membrane was cultured in an atmosphere of 10 per cent. carbon dioxide on the surface of a liver agar plate for two days at 37° C. Viable counts gave an average of 15 organisms per 1/50 ml. of the one-in a million dilution.

Therefore this dilution, of which 0.1 ml. was taken, contained  $15 \times 50 = 750$  viable organisms per ml. The membrane filter should therefore have yielded approximately 75 colonies.

The actual number of colonies resulting on the membrane was 31 (Fig. 8). They were well defined and clear. Thus, the method appears to be satisfactory for this organism.

The modified technique, using opacity tubes, was necessary because of the slow rate of growth of this organism. The viable count was used to check the opacity reading instead of being performed before the experiment.

*Neisseria meningitidis*. The organism was grown for twenty-four hours on "chocolate" agar : 225 viable organisms were filtered, but only 20 colonies developed after forty-eight hours. The method is unsuitable for this organism.

*Mycobacterium tuberculosis*. All efforts to grow this organism on the membrane, using a variety of methods, failed.

Certain organisms therefore appear to grow satisfactorily on the membrane but none in less time than by routine methods. Those organisms which grow satisfactorily do so from extremely small inocula and from this point of view the method was considered worthy of further consideration for the organisms concerned. These are : *Strep. pyogenes*, *Salm. typhi*, *Salm. paratyphi A, B* and *C.*, *C. diphtheriae* and *Br. abortus*. There is no advantage in the case of the first and last as it results in no acceleration of diagnosis, and the method does not appear to be indicated in other circumstances.

*The enteric organisms*. Although there appears to be no advantage in diagnosis it was felt that the method might be of use in epidemiological medicine—notably for the examination of kitchen and cookhouse wastes ; of urine for carriers ; of Moore's faecal swabs and possibly for the examination of filtered sewage.

*Sewage*. Sewage effluent from a London sewage plant was obtained and passed through the filter after preliminary coarse filtration, as it is known that turbid fluids are unsuitable for this method. Each 100 ml. of this effluent had previously had 40 viable *Salm. typhi* added. Unfortunately swarming bacilli, chiefly of the *Proteus* group, spoiled this experiment and every effort to overcome this difficulty failed. Water from Epping sewage effluent and Cobbin's Brook, known to contain *Salm. paratyphi B*, was also filtered, but *Proteus* organisms again spoiled the experiment. By cutting up the filter membrane and transferring the strips to selenite F. and thereafter culturing in the normal way as suggested by Taylor, Bowman & Oliver (1953), we were able to recover *Salm. paratyphi B* known to be present. We do not consider, however, that this method has any advantage over routine methods either in speed or selectivity.

*Moore's swabs*. Sterile Moore's swabs were adjusted in the outflow from lavatories. They were left *in situ* for four days and thereafter suspended in Kilner jars in 200 ml of sterile tap water to which had been added 40 viable *Salm. typhi*. After one hour the swabs were compressed against the jar with sterile rods and the fluid in the jars allowed to settle : 100 ml. of this fluid was passed

through the filter, but again *Proteus* organisms obscured the picture and the salmonellæ could only be recovered by sub-culturing strips of the membrane. Repetition after only two days' exposure of the swabs in the drain yielded similar results.

*Urine.* A random sample of normal urine was coarse-filtered and then prepared for experiment by adding 46 viable *Salm. typhi* to 100 ml. This was passed through the filter : 20 colonies were recovered. A background of urates rendered photographic illustration difficult and this picture has been omitted. The colonies were clearly visible to the naked eye and this suggests a promising method for pooled urines in carrier investigations. Filtration is, however, about four times as slow as in the other experiments described.

*C. diphtheriæ.* The ease with which this organism is grown on the membrane from minimal inocula suggested a use in multiple swab examinations. Swabs were therefore taken at random from two healthy throats and each shaken for an hour in 100 ml. sterile water, to which had been added 20 viable *C. diphtheriæ mitis* type. The resultant fluid was passed through the filter. In both cases a full complement of colonies resulted and there was no interference from throat commensals. It proved an excellent method for mass examination for throat swabs.

## CONCLUSIONS

The advantages of membrane filters are well known in the bacteriological investigation of water, both for coliform counts and for the recovery of enteric organisms. In clinical diagnosis the method may be useful where organisms are scarce and in some cases it is as rapid as conventional methods. The advantages, however, are not sufficient to warrant its adoption as a routine diagnostic measure. In epidemiological medicine, on the other hand, the procedure has a definite place.

In the investigation of enteric outbreaks it can be used for the examination of kitchen and sullage waters, provided they are not too turbid, and in the examination of urine for carriers. In diphtheria it is useful in the mass examination of throat swabs.

The great advantage of the method is that any amount of fluid can be filtered with a minimum of expenditure of plates. Pooled urines can be examined at one sitting and any organisms present can be recovered. For example, the urines of 200 food handlers could be examined in batches of 20. Any batch yielding a positive result could be re-examined individually, either by membrane methods or by routine culture. If a method of removing swarming organisms could be evolved this method could also be applied to fæcal swabs. Similarly 200 throat swabs could be examined in batches of 20 by the method described and any positive batches re-examined individually. In this way there is a great saving of time and materials and very small numbers of organisms can be detected.

## SUMMARY

The membrane filtration method described by Goetz and Tseuneishi for the recovery and counting of *Bact. coli* in water has been applied to a variety of organisms. Apart from *Bact. coli* in water, certain organisms are readily recovered by this method, notably the enteric organisms, *C. diphtheriæ*, *Br. abortus* and some streptococci.

By removing the filter pad and culturing the membrane directly on a solid medium even better results have been obtained.

The method has been described and the results with various organisms reviewed. Although of no special aid in routine diagnosis it should prove a rapid method for detecting urinary enteric carriers and diphtheria carriers by mass examination. It is also recommended for examining kitchen and cook-house waste waters and tap water for enteric organisms.

It is felt that this method has a definite place in epidemiological medicine.

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# NEUTRAL RED AS A TEST REAGENT IN THE CHLORINATION OF WATER

BY

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## I. THE USE OF NEUTRAL RED TABLETS WITH THE WATER TANK TRUCK

NEUTRAL Red in acid solution is bleached to yellow or rendered colourless by effective concentrations of free chlorine, which act rapidly on organisms, but is unaffected by chloramine, which acts slowly on organisms.

The basis of the sterilizing treatment here described is superchlorination with four parts of free chlorine per million, followed by a check test of the water with Neutral Red tablets to ensure the presence of two or more parts of free chlorine per million, and then dechlorination with taste remover tablets.

Two or more parts of free chlorine per million in 180 to 200 ml. of water will bleach 0.6 mg. of Neutral Red in acid solution, but less than that amount of chlorine will not bleach the dye and the mixture remains red.

Water polluted with sewage contains ammonia, which forms chloramines with any undeviated chlorine in the water. These chloramines may not kill the organisms in a contact time of one hour or more. The advantage of this test is that it neglects the presence of such sterilizing agents and shows the presence of free chlorine only.

## MATERIALS AND METHOD

### *Materials*

The Neutral Red found most suitable is Neutral Red, C.I. No. 825;\* other makes tested contained substances which left a strong yellow colour in the water after bleaching, thus masking the colour change to a great extent.

The acid found most suitable for making into tablets is betaine hydrochloride, a non-toxic by-product in the manufacture of beet sugar. Sufficient must be added to acidify the water in the test and 0.3 g. is enough for natural waters.

It is emphasized that all apparatus must be cleaned thoroughly before and after use by rinsing in clean water. The following are required :

- (a) One half-pint enamelled or synthetic resin mug.
- (b) One chromium-plated brass rod, 5 in.  $\times$   $\frac{1}{4}$  in., with mushroom end.
- (c) One tin of water sterilizing powder.
- (d) One white cup made of synthetic resin ( $\frac{1}{2}$  pint or 180 to 200 ml.).
- (e) One container of Neutral Red tablets.
- (f) One tin of taste remover tablets.

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\* Supplied by Messrs. G. T. Gurr, London.

### Method

Fill the 200-gallon tank of the Water Tank Truck with filtered water.

Meanwhile mix eight (or four, see note 2 overleaf) level scoopfuls of water sterilizing powder in the half-pint mug with filtered water.

Add this suspension to the water in the tank, rinsing in any powder adhering to the mug.

Mix the contents of the tank when full with the paddles and leave for fifteen minutes (time to smoke a cigarette) with the paddles in the tank. After this interval, or after thirty minutes (see note 3), allow a few pints of the water to run to waste from each tap and collect a sample in a clean white cup, which must be filled to the brim (200 ml.).

Place one Neutral Red tablet in the cup and, with the mushroom end of the metal rod, break up the tablet and stir until it has all dissolved.

Wait one minute and note the colour of the water in the cup.

Normally, the water will have a faint yellow colour or it may be colourless and it will be safe to drink after the taste has been removed.

To remove the taste, mix eight taste remover tablets in the mug with sterilized water from the tank, using the clean metal rod to break them. When dissolved, pour this into the tank, mix with the paddles and the water will then be ready for issue.

If, on the contrary, the Neutral Red test gives a red colour, the water has less than two parts of free chlorine per million and is not safe to drink. In this event, a further two (or one, see note 2) level scoopfuls of water sterilizing powder must be mixed with filtered water and added to the water in the tank. Mix with the paddles and proceed as above, repeating the Neutral Red test.

Water sterilizing powder must be added until on testing with the Neutral Red tablets, a faint yellow or colourless result ensues. Then add the eight taste remover tablets before issue.

Extra water sterilizing powder may be required in the case of :

- (a) A very badly polluted water.
- (b) Defective water sterilizing powder.
- (c) Pollution with war gases, *e.g.* sulphur mustard gas, which will be destroyed if there are two parts of free chlorine present as shown by the test.

The only foreseeable fault in the method is in the use of dirty apparatus, especially contamination of the rod and the white cup with water sterilizing powder, when in use for the Neutral Red test.

### Notes

1. The Neutral Red test can be carried out by units with Cases, Water Testing Sterilization, provided Neutral Red tablets are available. The tommy bar of the box spanner in the tool kit of a vehicle can be used to break up the dye tablet, provided it is thoroughly clean. If tablets are not available, a 2 g. water sterilizing powder scoopful of a 0.03 per cent. solution of the dye in 1 : 1



dilute glacial acetic acid may be used instead of one tablet, but the scoop must be freed from every trace of water sterilizing powder before use.

2. The scoops at present issued with the tins of water sterilizing powder are 2 g. scoops, but larger scoops holding 4 g. of water sterilizing powder are being issued with the new cases. Four of these larger scoopfuls of water sterilizing powder will be required for 200 gallons of water instead of eight of the smaller scoopfuls. The scoops may be distinguished easily with the aid of a halfpenny; the coin fits inside the large scoops but not in the small ones.\*

3. The time of contact should be increased from fifteen to thirty minutes under the following conditions :

- (a) In very cold climates, where the temperature of the water is near freezing point. A low temperature slows down the action of chlorine on organisms, whereas a high temperature accelerates it.
- (b) In areas where schistosomiasis is rife. The cercariæ in the water, which cause the disease, are more resistant to the chlorine than bacteria.

4. Any staining of the cup by the dye can be removed by adding a knife point of water sterilizing powder to water in the cup. Thorough cleansing with water is necessary to get rid of the last traces of water sterilizing powder before using the cup for the test again. It is better to prevent staining by cleaning the cup immediately after the test.

### SUMMARY

A new method<sup>7</sup> of water sterilization by superchlorination followed by a check test with Neutral Red tablets is described.

The procedure is as follows :

Ensure all apparatus is clean.

Fill the tank with filtered water.

Stir the suspension of water sterilizing powder into the tank full of water.

Wait fifteen minutes.

Allow taps to run to clear untreated water from pipes.

Carry out the Neutral Red test.

If the test gives a faint yellow or no colour, stir in taste remover tablet solution.

Issue the water.

If the test gives a red colour, add further quantities of water sterilizing powder until no red colour results in the repeated test after fifteen minutes' contact of the powder with the water. Then add the taste remover tablets in solution and issue the water.

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\* The larger scoops in the tins of water sterilizing powder will in future be embossed with the figures "60," i.e. 60 grains.

## II. THE DETERMINATION OF FREE CHLORINE IN WATER IN THE PRESENCE OF CHLORAMINE

The bleaching action of free chlorine on Neutral Red dye in acid solution is quantitative in the proportions of chlorine used in water treatment. A simple titration of the acidified water with a standard solution of the dye is all that is necessary to ascertain the proportion of free chlorine in the water.

Methods for the determination of free and combined chlorine in water supplies have been reviewed by Houghton (1950); also Milton (1949) has devised a method using cyanide, and this has been modified by Morris & Grant (1951). Most of these methods are complex, are influenced by the presence of iron, manganese or nitrites in the water, or require the use of such poisons as arsenic or cyanide. Holwerda (1928) and Taras (1946 and 1947) investigated the determination of free chlorine by means of its bleaching action on methyl orange. Of many dyes tested, Neutral Red in acid solution was found to be the most satisfactory and in the following method it was found that chloramine, iron, manganese and nitrites, in the proportions present in natural waters, did not interfere. Results, also were correct to 0.1 parts of free chlorine per million.

### MATERIALS AND METHOD

#### *Materials*

The following are required :

- Neutral Red C.I. No. 825, 0.3 g. per 1. aqueous solution.
- Acetic acid, glacial.
- Beakers, 400 ml., 2.
- Stirring rods, glass, 2.
- Measuring cylinder, 200 ml., 1.
- Measuring cylinder, 10 ml., 1.
- Micro-burette, 2 to 3 ml., with stand.
- White tile.
- Litmus paper.

#### *Method*

Into one beaker marked "Control" measure 200 ml. of the water to be tested, add a crystal of sodium thiosulphate to destroy the chlorine in the water and stir to dissolve.

Measure 200 ml. of the water to be tested into the other beaker.

Add to each sufficient acetic acid to make the water more acid than  $\text{pH}=6.8$  (that is, distinctly acid to litmus paper, tested with the control). Usually 1 ml. is sufficient.

To the control, add the dye solution from the burette drop by drop until, after stirring, a distinct red colour appears when viewed against the white tile. Generally 0.1 to 0.125 ml. is required.

Then titrate the test solution in the other beaker until the colours in the two beakers match permanently. As it takes about one minute for the bleaching to

take place, allow about two minutes between the addition of the dye and the observation of the end point of the titration.

Deduct the burette reading of the control from that of the test and the result in millilitres gives the proportion of free chlorine in parts per million direct.

It may be advisable with fresh batches of the dye to check the results with chlorine gas in distilled water, using ortho-tolidine or an iodometric method.

## RESULTS

Tables and details of results are omitted for the sake of brevity. The essential findings were as follows :

- (a) With chlorine gas added to ammonia-free distilled water or to London tap water, which is alkaline and virtually free from ammonia, the results obtained by the Neutral Red titration agreed with the known proportion of chlorine added and with determinations made by the iodometric and orthotolidine methods.
- (b) With water sterilizing powder and the two waters described above, the method gave results agreeing with the chlorine added and the two check methods given above.
- (c) When chlorine gas and ammonium hydroxide were added to distilled water, the Neutral Red showed the absence of free chlorine until a ratio of four parts by weight of chlorine to one part of ammonia was reached. With higher proportions of chlorine, free chlorine appeared in the mixture and bleached the dye.
- (d) When chlorine gas and ammonium sulphate were added to distilled water, a result similar to (c) above was obtained.
- (e) When chlorine gas and ammonium sulphate were added to alkaline London tap water, the formation of chloramine was delayed and free chlorine was found in the water for several minutes. For example, with a 1 : 1 ratio of chlorine to ammonia, chlorine was found after one minute's contact but not after five minutes, although by iodometric titration it was found that all the chlorine added remained. With a 4 : 1 ratio of chlorine to ammonia the time of conversion to chloramine was longer, chlorine being found after ten minutes' contact, but after fifteen minutes no free chlorine was present. Iodometric titration showed that all the chlorine then remained as chloramine.
- (f) Iron added as ferric chloride up to five parts of iron per million did not interfere with the Neutral Red titration of added chlorine. The end point was a little difficult to perceive with water containing the higher concentrations of iron owing to the brownish yellow colour due to the iron.

In the case of water containing two or less parts of chlorine per million, good agreement was obtained between the Neutral Red and

iodometric titrations although the latter was a difficult determination owing to the rapid return of the blue starch iodide colour.

When the chlorine was raised to three parts per million, the two methods did not agree, the iodometric method showing a lower result than that of the Neutral Red. This anomaly requires further investigation.

- (g) Manganese chloride added to a maximum of five parts of manganese per million did not affect the results.
- (h) Sodium nitrite added to the water to give one part of nitrogen per million deviated more than two parts of chlorine per million. One tenth of this proportion of nitrite deviated approximately one part of chlorine per million. With the latter proportion of nitrite in the water, the Neutral Red and iodometric methods showed the presence of one part of chlorine per million less than the amount of chlorine added to the water and were in agreement. It was necessary in the iodometric titrations to destroy the nitrite with acid permanganate and oxalic acid before titration of the water. Therefore, apart from deviation of chlorine, nitrites do not cause any effect.

### SUMMARY

A method for the quantitative determination of free chlorine in water using Neutral Red is described.

Chloramine, iron, manganese and nitrites do not interfere with the test. A summary of results is given.

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# SOME OBSERVATIONS RELATING TO THE STERILIZATION OF SYRINGES

## II. BY THE HOT AIR OVEN

BY

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## INTRODUCTION

THE use of hot air for sterilizing syringes is common in hospitals and laboratories throughout the country and a variety of ovens are available for this purpose. Darmady & Barrington Brock (1954) have, however, shown that ovens differ in their efficiency and that wide variations in temperature and in the uptake of heat by syringes may occur in certain types. They found that an electric oven with a fan is superior to one without a fan and that a gas-heated oven is generally unsatisfactory for the sterilization of syringes.

Within the last few years many military laboratories and some military hospitals have been issued with thermostatically controlled electric ovens and these have largely replaced the older gas-heated ovens. The experiments reported below were designed to test the efficiency of one of these ovens and to investigate the reliability of a simple indicator of sterilization.

## EQUIPMENT

*Hot air oven.* This was an electrically operated thermostatically controlled oven of internal dimensions 18×18×15 in. The heaters were located in each side and in the base. There was no fan. A thermometer was placed through the centre of the air vent on the top of the oven and recorded "oven temperature." The oven was divided by a shelf.

*Maximum thermometer.* This was inserted into a test tube plugged with cotton-wool.

*Coloured indicator tubes.\** These contained a red liquid which the manufacturers claim changes colour to green on exposure to 160° C. for one hour. One was placed inside each divided plunger of a number of "indicator syringes" (Plate III, Fig. 1).

*All glass syringes.* Syringes were lubricated with silicone M.S.550, assembled with a needle attached and inserted into a test-tube which was then plugged.

*Contaminating cultures.* Cultures used were :

*Staphylococcus aureus* in digest broth.

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\* Supplied by Messrs. A. Browne, Ltd. of Leicester, as "Browne's tubes No. 3."

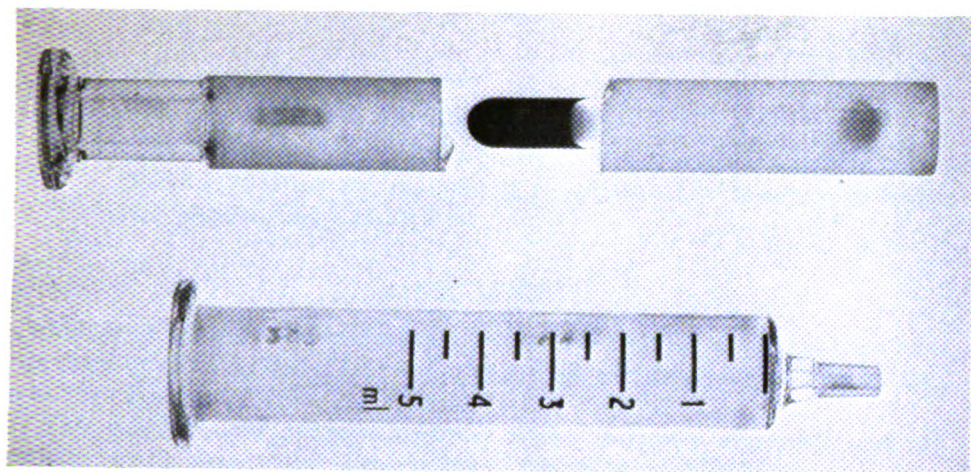


Fig. 1. Syringe with Indicator Tube.

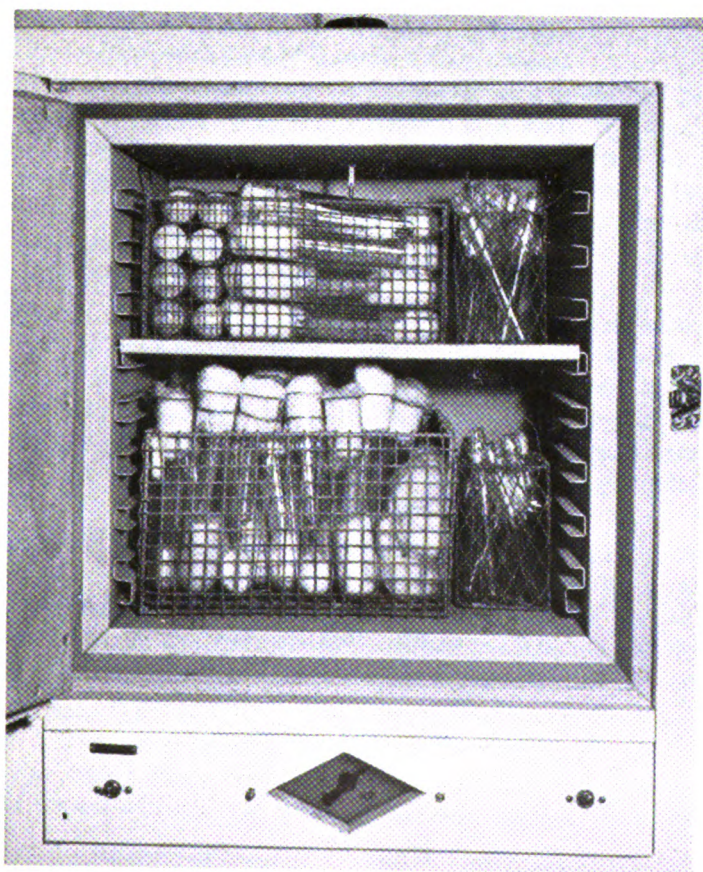


Fig. 2. The Oven Loaded.

PLATE III





*Bacillus subtilis* in peptone water.

*Bacillus megatherium* in peptone water.

*Bacillus cereus* (N.C.T.C. 9687) grown in the medium recommended by Stokes (1955) for the production of spores. The presence of spores was confirmed by a stained film.

## METHOD

A number of syringes were sterilized in another hot air oven and then contaminated by drawing the culture into the syringe and expelling it. The syringes were then dried at 37° C.

The contaminated syringes together with "indicator syringes" and uncontaminated syringes were then packed in four baskets (Fig. 2).

Two large baskets were tightly packed with syringes arranged horizontally and vertically respectively. The test-tube containing the maximum thermometer was placed in the centre of the horizontally packed syringes.

Two smaller baskets were packed loosely with syringes.

After sterilization, the maximum thermometer and indicator tubes were inspected and the contaminated syringes tested for sterility by drawing digest broth into the syringes and then returning all but a few drops into the bottle of broth. Three drops of the remainder were plated on to an agar plate.

Control syringes were contaminated and cultured as described above but were not subjected to sterilization.

All contaminated syringes were autoclaved after each test.

**Pilot experiment.** The oven was loaded cold, then raised to an oven temperature of 132° C. and held there for one hour. All syringes contaminated with *Staph. aureus* and *B. subtilis* were sterilized. *B. megatherium* and *B. cereus* were each recovered from several syringes, the latter more often than the former. All control syringes gave positive cultures and no indicator tubes showed any colour change. All further experiments were therefore carried out using *B. cereus* only.

**Oven loaded cold.** The oven was loaded cold and allowed to heat to the desired temperature at which it was held for one hour except at 180° C., when only half an hour was allowed for sterilization. The horizontally packed syringes were placed on the shelf and the vertically packed syringes on the floor of the oven except in one test (1F—see Table 1) when the positions were reversed.

**Oven loaded hot.** The oven was heated to the required temperature, then loaded. After loading the temperature dropped, then rose again gradually. Sterilization was timed from the minute the desired oven temperature was regained. The basket with the horizontally packed syringes was placed on the shelf.

**Indicator tubes.** Separate experiments were carried out with loose indicator tubes in order to obtain information on the temperature and time required to change the indicator to green.

## RESULTS

*Sterilization experiments.* The results obtained are shown in Table 1 and are discussed below.

*Indicator tubes.* In experiments on loose indicator tubes a partial change in colour was noted after fifty-five minutes at 160° C. in air and complete change to green after 60 minutes. Observations made during the main work described above and during previous unpublished experiments have suggested that slightly higher temperatures or longer times may be necessary to effect complete change in some instances.

## DISCUSSION

Although the method used in the above experiments did not produce a continuous record of temperature changes such as was obtained by Darmady & Barrington Brock (1954) using multiple thermo-couples, the results strongly suggest that considerable variations in temperature occur in the type of oven used, depending on position within the oven, method of placing, etc.

The finding of more positive cultures from the syringes on the floor of the oven indicates that the temperature in the tubes on the shelf was generally higher than in those on the floor. In the one experiment (1F) when the horizontally packed syringes and maximum thermometer were on the floor the findings were unexpected, the temperature in the lower basket being higher than the oven temperature. It is considered that this probably resulted from conduction from the underlying heater.

That heat does not penetrate tightly packed syringes as readily as it does loosely packed syringes is borne out by the finding of more positive cultures from the centre of the large baskets than from the side and from the loosely packed small baskets.

Until recently it was usual to recommend that ovens be loaded cold, but Darmady & Barrington Brock (1954) found that time was gained and no efficiency sacrificed if ovens were loaded hot. Our findings support the latter view.

In deciding at what temperature sterilization will be carried out it is important to remember that the oven must be maintained at a temperature which will sterilize syringes irrespective of their position in the oven. In our experiments sterilization was achieved in one hour at an oven temperature of 160° C. but not at 150° C. The variety of published recommendations on sterilizing temperature levels has been reviewed by Darmady & Barrington Brock (1954), but 160° C. for one hour is commonly recommended in this country (M.R.C., 1945 ; Mackie & McCartney, 1953 ; War Office, 1956).

The regular testing of the efficiency of a hot air oven is essential. Bacteriological tests are necessary from time to time, but apart from difficulties connected with the production of a suitable test suspension, suffer from the disadvantage that delay is inevitable. The chemical indicator tubes are convenient to handle

Table 1.—Results of the hot air sterilization of syringes.

## I. OVEN LOADED COLD

Test	Oven Tem- pera- ture °C.	Time	SHELF						FLOOR									
			Large Basket						Small Basket		Large Basket						Small Basket	
			Centre			Side			Culture	Indicator	Centre			Side			Culture	Indicator
			Culture	Indicator	Max. Temp. °C.	Culture	Indicator	Culture			Indicator	Max. Temp. °C.	Culture	Indicator				
A	133	1 hr.	+	R	122	—	R	—	R	+	R	·	+	R	—	R		
B	140	1 hr.	+	R	131	—	R	—	R	+	R	·	+	R	—	R		
C	150	1 hr.	+	R	142	—	R	—	R	+	R	·	+	R	—	R		
D	160	1 hr.	—	R	159	—	G	—	G	—	R	·	—	R	—	RG		
E	160	1 hr.	—	R	155	—	G	—	G	—	R	·	—	R	—	RG		
F	160	1 hr.	—	R	·	—	R	—	R	—	G	170	—	R	—	RG		
G	180	$\frac{1}{2}$ hr.	—	R	178	—	G	—	G	—	RG	·	—	R	—	G		

## II. OVEN LOADED HOT

A	141	1 hr.	+	R	130	+	R	—	R	+	R	—
B	150	1 hr.	—	R	147	—	R	—	R	+	R	—
C	161	1 hr.	—	R	154	—	RG	—	R	—	R	—
D	180	$\frac{1}{2}$ hr.	—	R	174	—	G	—	R	—	R	—

All control syringes gave a positive culture of *B. cereus*.

R = Red. RG = Incomplete change. G = Green. + = Contaminating organisms recovered. — = Contaminating organisms not recovered.

(although they must be stored in a refrigerator) and can be read immediately. As regards reliability, in no instance did we obtain a positive culture from a syringe adjacent to a tube which had turned green, which in our experience required a temperature of 160° C. for at least one hour. To ensure that these tubes turn green it may be necessary to prolong sterilization slightly beyond one hour. Colquhoun (1954), describing a syringe service, mentions the routine use of this chemical indicator to check sterilization which he carries out at 170° C. for one and a half to two hours. As a routine we now insert an indicator tube with every second or third batch of syringes and always pack one with a sternal puncture needle.

### SUMMARY

Sterility of syringes as judged by the killing of spores of *B. cereus* can be achieved at 160° C. for one hour in the hot air oven tested.

Syringes should not be packed too tightly.

Loading the oven hot does not interfere with sterilization.

The chemical indicator tested appears to be satisfactory.

I wish to thank Brigadier G. T. L. Archer, M.R.C.P.I., Q.H.S., Director of Pathology, for suggesting this investigation, and Corporal Goodwin, R.A.M.C., for much technical assistance.

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# **SURGERY IN PULMONARY TUBERCULOSIS IN ARMY PERSONNEL AND THEIR DEPENDANTS**

## **A GENERAL SURVEY**

BY

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## **INTRODUCTION**

THE Connaught Hospital (Army Chest Centre) receives cases of pulmonary tuberculosis from the Army all over the world, and the patients comprise Regular and National Service soldiers as well as their wives and members of the Women's Forces. Children under 18 years of age, however, are not admitted. Approximately one-half of the cases admitted are transferred for completion of treatment to civilian sanatoria. The other half are retained at the Connaught Hospital.

This paper is a general account of the surgical work carried out here for pulmonary tuberculosis. A more detailed report on the results of lung resection at this centre is being prepared.

In the Army Chest Centre a plan of treatment is prepared for all patients suffering from pulmonary tuberculosis. Two factors apply to every case, namely :

- (a) Bed rest and sanatorium régime.
- (b) Antibacterial drug therapy.

Each case is then reviewed at intervals and further measures considered which might continue improvement and facilitate final cure. These are :

- (a) Pneumoperitoneum.
- (b) Resection—viz. pneumonectomy, lobectomy, segmental resection, wedge resection (unilateral or bilateral).
- (c) Thoracoplasty (unilateral or bilateral).

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**This paper was read at the Pan Malayan Tuberculosis Conference, Singapore 1-3 November, 1956.**

### PNEUMOPERITONEUM

are is used in this hospital under two sets of circumstances. First, used in the preparation of cases for thoracoplasty ; furthermore these be improved to such an extent that resection becomes possible rather than thoracoplasty. Secondly, it can be used as a protective measure in certain cases of bilateral disease which are unsuitable for surgery or in those patients who have refused it.

The indications for artificial pneumothorax are now very few and this procedure has not been carried out in this centre for more than three years.

### RESECTION

The past six years have seen the general acceptance of lung resection as a definitive form of treatment for certain types of tuberculosis. This advance in the therapy of the disease has made it possible to retain in the Army many people who would otherwise have been invalided from the service. This has been to the advantage both of the Army, which has been able to retain the services of key personnel, and of the individuals concerned, who have been enabled to finish their careers as planned.

The success of this measure has been made possible by modern antibacterial drugs combined with the increasing ingenuity and skill of thoracic surgeons and their teams. As time passes, the results of lung resection continue to improve steadily. Cases for resection can be divided into two groups : (a) those in whom the operation is performed for the removal of persistently active disease which cannot be controlled by other measures such as bed rest, chemotherapy and pneumoperitoneum, and (b) those in whom the disease has been well controlled by other measures and in whom resection offers an alternative to long-term chemotherapy.

The first group includes the more advanced forms of tuberculosis such as those cases with gross tuberculous bronchostenosis and bronchiectasis, tuberculous empyemata and destroyed lungs.

Resection in such cases is advised because it offers the only chance of a permanent cure. The only alternative to operation is prolonged invalidism, and in these forms of disease the value of resection (which will often necessitate a total pneumonectomy) is not disputed. The number of such cases is likely to diminish in the future as the effects of mass miniature radiography and of improved facilities for early diagnosis and treatment result in fewer cases reaching such an advanced stage.

At this centre we see very few of these cases, and only 3 out of a total of 125 resections from the middle of October, 1953, until the end of 1955 have been performed for disease of this advanced nature.

The second group, which includes the majority of cases dealt with at the centre, is made up of solitary circumscribed solid lesions, often symptomless and revealed on routine radiography ; and the end results after medical treatment of relatively localized disease. These radiographic end results are, in the

cases dealt with here, usually solid but may be cavitated. The reason for resection in cases of this second group, comprising well-controlled disease, is to prevent a spread of the disease in later life; in fact, it is a prophylactic operation.

Over the last few years there has been considerable controversy regarding the merits and demerits of surgery in cases of this type, particularly in those showing very little radiological evidence of disease after a preliminary course of bed rest and drugs. Now that the possibilities of long-term chemotherapy (lasting two to three years) are becoming apparent, it is likely that the controversy will become fiercer.

Our view is that until the benefits of long-term chemotherapy have been properly assessed, the treatment of choice for patients in the second group is resection, provided the disease is of such a character and extent that it can be excised. This poses the question of what is "excisable" and what is not, and in considering this question both the character and the extent of the disease must be borne in mind.

Solid disease is the favourite for excision whether it be the solitary well-circumscribed lesion (which on tomography is frequently shown to be surrounded by satellites) or the nodular type of disease often seen at the end of the course of medical treatment. Cavities are not usually excised until a course of medical treatment, combined with postural treatment and possibly a pneumoperitoneum, has failed to close them.

As regards the extent of disease which can be excised, one should consider first the minimal amount of disease which should be removed and, secondly, the maximum amount of disease which can be removed.

Taking the very small or "minimal" solid lesions first: which should be left alone, and which should be excised?

Many authorities use some arbitrary standard of size on the radiograph to help decide whether to advise excision or not: 1-2 cm. across is the figure usually given, a diameter exceeding this usually indicating excision. As solid disease of more than this extent is usually found to contain caseous material, this is a sound criterion, for caseous matter, however well encapsulated, can not be relied on to remain stable.

Our criterion is that any solid disease should be considered for resection if the radiological appearances suggest that the shadows are due to anything more than fibrous scarring. This implies a thorough assessment of the history of the case because the events leading up to the final radiographic appearances are bound to affect the ultimate decision. Thus a cavitated lesion which has become blocked and contracted down to a small size will be more liable to break down later, and is therefore a more definite indication for excision, than a more extensive, but softer infiltrative, uncavitated lesion, which after medical treatment has left nothing but a few tiny nodules in the final radiograph.

Our reasons for advising excision in these small lesions are:

(a) Even apparently healed lesions have been shown by several authorities, and confirmed by our own pathological findings, frequently to contain viable



tubercle bacilli and to show evidence of activity on microscopy. This may be so even after many months of pre-operative chemotherapy.

(b) Clinical experience shows that the breakdown rate of these lesions, although not accurately known, is considerable. The surgical removal of those areas of lung which are shown by radiography or which can be felt at operation to be diseased should reduce this breakdown rate. Only a long-term follow-up will show whether what seems a logical procedure serves its intended purpose. In the meanwhile the operation in skilled hands is safe and in our experience post-operative spread of disease has not so far occurred. The patient is spared the anxiety of harbouring a potentially dangerous focus in his lungs and its removal means that the patient can be restored to full activity sooner than if it were left alone. From the service point of view this means a more rapid return to a higher medical category.

When one comes to consider the upper limits of excisability, it has been found that in young patients a larger area of lung can be removed than was formerly thought possible. Thus the upper lobe (including the lingula) and the apical segment of the lower lobe on the same side have been removed in young people with adequate filling of the hemithorax by the remaining segments. Bilateral resections are also carried out and three segments on both sides can be removed without causing undue post-operative dyspnoea.

Resection in the cases discussed in the foregoing paragraphs has usually been of the total diseased area. Recently there has been a tendency to broaden the scope for resection still further by excising in widespread cases not the total amount of diseased lung but only that part of it which might be considered as having been the source of the spread within the lung. An example would be a persistent cavity in the apex or the apical segment of the lower lobe with bronchial spread to the middle and the lower lobe. Such a case might be too extensive for resection of all the diseased areas of lung, but by excising the cavitated area, whence the rest of the infection has spread, it is believed that the main potential source of danger for the future has been removed and that with adequate antibiotic therapy, and possibly also a protective pneumoperitoneum, the remainder of the disease will remain stable.

Many surgeons employ some space-reducing measure after resection of more than one or two segments in order to prevent overdistension of the remaining part of the lung. This may take the form of a phrenic crush or of a small thoracoplasty performed at the same time as, or shortly after, resection. This has been advocated because published results show that if spread of disease is going to occur after operation, it is more likely to do so if the remaining lung is overdistended.

There is no doubt, however, that after resection the respiratory reserve is very much lower if space-reducing measures have been used, and accordingly it is not the practice at this centre to use them except very occasionally such as when a total pneumonectomy has been done and we wish to avoid overdistension of the opposite lung. It has been shown that when spread of disease occurs after resection, it usually does so in areas of disease which for technical

or other reasons have been left unexcised at operation. In the great majority of our cases all radiologically visible and palpable disease is removed. We therefore feel that the chances of post-operative spread of disease is small, provided chemotherapy has been adequate.

#### *Pre-operative treatment*

The initial treatment of all cases of tuberculosis is medical and consists essentially of rest in bed and anti-tuberculous drugs together with posturing, pneumoperitoneum or both, in selected cases. A long-term plan of treatment is drawn up for each patient and surgical opinion is sought early even although it may be some time before the case is suitable for surgery. In general, surgery should not be carried out as long as radiological improvement continues, and the optimum time for resection is when the maximum improvement by non-surgical means has been reached. This is usually judged on the radiological appearances, although the condition of the sputum, weight, E.S.R., temperature, pulse, respiration and general condition must also be considered.

The length of the pre-operative treatment depends on the type of the disease and its response to medical measures. Most of the cases at the Connaught Hospital have had three to six months' treatment and have received 90-120 g. of streptomycin (together with P.A.S. or I.N.A.H.) before they have been regarded as suitable for resection, but some cases may safely be operated on in less time (more particularly those with rounded symptomless foci and negative sputum) and some may take much longer before their radiological end point is reached.

During the week before operation the patient is taught the breathing exercises which will later play an important part in the post-operative treatment.

#### *Post-operative management and disposal*

Daily physiotherapy for shoulder movements and breathing exercises are begun the day following operation. Uncomplicated cases begin their "upgrading" (at a rate of one hour every ten days), twenty-eight days after operation, and army patients are sent out on sick leave when they are up seven hours—that is about fourteen weeks after operation. After leave, they return to the Army Chest Centre for review and are usually returned to duty in Category P.7(H.O.) within six months of the operation.

Antibacterial drug treatment is continued until the time of discharge from hospital. Recently, however, we have extended this to cover the leave period as well, and it is probable that in future oral drugs will be continued for some months even after return to duty.

### THORACOPLASTY

As the scope for resection of tuberculous areas of lung has increased, so the absolute indications for thoracoplasty have diminished. In this centre we consider that resection is the treatment of choice whenever possible and thoracoplasty is indicated only in those cases which are unsuitable for resection on grounds of age, or the nature, character and extent of the disease.

These include cases where cavity closure cannot be effected by conservative means and which are too extensive to resect. Such cases are usually bilateral and may require thoracoplasty on both sides. It is also felt that even when cavities have been closed by conservative means, some permanent form of collapse therapy may still be required if resection is not possible.

The operation is never undertaken hurriedly and every effort is made to render the sounder of the two sides quiescent before carrying out a thoracoplasty on the other side. This may involve anything from six to eighteen months' pre-operative treatment with rest, antibacterial drugs and often a pneumoperitoneum.

A one-stage osteoplastic procedure, usually involving five or six ribs, is carried out in this centre. This has obvious psychological advantages over the two- or three-stage operations.

#### *Post-operative management and disposal*

Physiotherapy is begun soon after operation as for resections, but upgrading is not usually commenced before six to eight weeks have elapsed after operation even in the uncomplicated case. In some cases this period may be longer. Certain special cases with relatively small areas of disease who have had unilateral thoracoplasty may be considered for retention in the service, but in our experience such cases are uncommon. The number is likely to diminish further as the scope for resection increases.

Antibacterial drugs are always continued up to the time of discharge from hospital, but recently there has been a tendency in some civilian centres to prolong post-operative courses of chemotherapy for one, two or even three years, and in future this trend will be reflected in our practice here.

### SURGERY IN THE PREGNANT FEMALE

It sometimes happens that the wives of serving soldiers are sent here during pregnancy, having been found to have pulmonary tuberculosis. The same principles regarding selection and pre-operative treatment are observed for pregnant as for other cases, but thoracoplasty is best delayed until several weeks or months have elapsed after parturition.

Resection, on the other hand, may safely be carried out during pregnancy, when it should be done during the second trimester, preferably at about four and a half months.

### SUMMARY

A general survey has been made of the surgical procedures carried out at the Connaught Hospital (Army Chest Centre) for cases of pulmonary tuberculosis. The indications for these procedures have been stated and the disposal of post-operative cases indicated.

We wish to extend our thanks to Mr. Kent Harrison, M.D., F.R.C.S., consulting thoracic surgeon to the Connaught Hospital, for his advice and encouragement.

## AN OCCURRENCE OF TOXIC CONVULSIONS DUE TO POISONING WITH *ILICUM RELIGIOSUM*

BY

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DURING the first two weeks of November, 1955, eleven cases of convulsions were reported amongst the troops of 22nd Special Air Service Regiment operating in the jungles of Malaya. Cases occurred in different squadrons situated in widely separated areas of jungle. Four men who suffered from these convulsions were subsequently questioned and an account of their condition during the attack obtained from eye-witnesses.

The histories were briefly as follows :

*Case 1.* Trooper H., engaged on a training operation. An hour after eating his evening curry meal, this man fainted and remembered nothing else until regaining consciousness. An eye-witness described his condition during the short period of unconsciousness as "frothing at the mouth, face turgid and momentary cessation of respiration." He first held his body rigid with the knees flexed on the abdomen, then proceeded to roll from side to side with accompanying limb movements (presumably tonic followed by clonic convulsions). On regaining consciousness he vomited his last meal. There was no history of incontinence or tongue biting.

*Case 2.* Trooper W., of "A" Squadron. An hour after consuming his evening meal, this man fainted and remembered nothing else until regaining consciousness ; following this he felt dazed for a few minutes and then vomited his last meal. The next day he felt quite well. An eye-witness described him as unconscious for five minutes. The pupils were noted to be dilated. His muscles were first observed to be taut ; following this he exhibited convulsive movements of his limbs. There was no history of tongue biting or incontinence.

*Case 3.* Trooper S., of Para Squadron. This man had two episodes over a period of eight days. On each occasion, an hour after the evening curry meal, he vomited, lost consciousness, and on coming to, noted that he had bitten his tongue ; again there was no history of incontinence. This man was subsequently evacuated by helicopter as a case of suspected epilepsy, but on returning to base exhibited no further fits. An eye-witness relates that during this man's periods of unconsciousness his teeth were clenched, he moaned and thrashed his limbs around. It was also noticed that his pupils were dilated.

*Case 4.* Lieutenant H., of "A" Squadron. Two hours after his curry meal this man was lying on his hammock when he noticed twitching of his limbs. He fell asleep

but awoke to find the twitching was more marked. He again fell asleep, but this time had a nightmare in which he thinks he had convulsions and cried out. He was roused by his orderly who found him on the ground where he had fallen from his hammock ; in falling he had dislocated his right shoulder. Later he vomited, but this was probably due to the morphia administered to relieve the pain of his dislocation. The following morning he was evacuated from the jungle for reduction of his dislocation. There was no history of incontinence or tongue biting.

These histories, together with the reports of the other seven cases of fits, resemble one another in that each occurred in the evening following a curry meal, consciousness was lost, convulsions were noted, vomiting usually occurred, and the individual was apparently quite well the following day. None of the four men questioned admitted to a personal or family history of epilepsy. It is not unreasonable therefore that the men themselves and their officers ascribed the cause of these episodes to something which had been eaten in the evening meal.

Troops in operations in the jungle usually consume one large meal in the day ; this is prepared in the late afternoon or evening before the dusk stand-to. Each man prepared his own food from a 24-hour ration pack.

At the time, 22 S.A.S. Regiment had been using a new, locally packed, 24-hour ration for British troops. The evening meal from this ration would consist of rice, tinned meat, optionally flavoured with curry powder from a packet, tinned peas, and a sweet consisting of dates, confectionery, or both. Soup, tea, and biscuits may also be consumed.

None of the men questioned admitted to adding locally purchased condiments or any locally found jungle foods to his meal. Only the contents of the rations were used. Further, the meal was heated by hexamine solid fuel cookers. Old petrol tins were not used for cooking, so that the possibility of poisoning by tetra-ethyl lead or some extraneous item could be excluded.

Suspicion as to the cause of these toxic convulsions fell on to the curry powder for two reasons. First, the other items of the ration—rice, tinned foods and confectionery, etc.—were all reputable brands and had been used by troops for some time. The curry powder, however, was a new addition to the ration and was prepared by a local contractor. Secondly, a few weeks prior to this outbreak of convulsions, the Royal Army Service Corps had removed the condiment *Bunga Lawang* (star anise) from the ration scales for Imperial Malay Troops. Star anise is used to flavour curries ; it is the fruit of *Illicium verum* and supplies are normally obtained from China. The Chinese variety of star anise is non-toxic. However, supplies of star anise from Communist China have been increasingly difficult to obtain in the Federation and Singapore, and merchants were obtaining supplies of a Japanese variety of star anise, the fruit of *Illicium religiosum*. Although the two fruits are almost identical in appearance, *Illicium religiosum* is a bastard variety of *Illicium* found growing around Buddhist temples in Japan ; it contains a highly poisonous fraction, the convulsant activity of which has been known for some time. Langaard, quoted by Blythe (1906)

described an instance of poisoning with *Illicium religiosum* of five Japanese children in 1880. Sze Yee Chem (1929) also gives an account of the toxicology of this fruit, and Simpson (1935) ascribed the death of a male Tamil to drinking milk containing powdered Japanese star anise. Medicinal properties have been attributed to star anise by the Chinese and it is also reputed to be an aphrodisiac.

Following an instance of poisoning of nine Malay Police Constables in Singapore where the cause was attributed to Japanese star anise (Wong Poi Kwong & Wan, 1955), and because the Japanese variety of star anise could be easily mistaken for the true non-poisonous Chinese variety, the R.A.S.C. withdrew star anise from the Malay ration scales.

The curry powder in the 24-hour, locally packed, ration for British troops, however, was mixed locally and was thought likely to contain star anise. In view of this suspicion, fifteen packets of this curry powder (each stated to contain 5 g.) were forwarded to the Army Food Laboratory for investigation.

The contents of these fifteen packets were defatted with petroleum ether and then extracted with alcohol. The alcoholic extract was evaporated and the resulting solution was extracted by the method used by American workers for the separation of anisatin from the fruits of *Illicium religiosum* (Lane *et al.*, 1952). The resulting extract was finally extracted with water and diluted to 15 ml. (1 ml. being equivalent to one packet of curry powder).

The solution was tested by Dr. R. G. Y. Lin, of the Department of Physiology, University of Malaya, by intraperitoneal injection into rats: 1 ml. of the extract produced typical convulsions in the rat in fifteen minutes, similar to the convulsions produced by an extract prepared from the fruit of Japanese star anise.

From these results it was assumed that the curry powder contained toxic Japanese star anise fruits from *Illicium religiosum*. This particular curry powder has been withdrawn from the ration scales and has been replaced by an Indian curry powder, guaranteed not to contain star anise. No further cases of convulsions have been reported.

It is of interest to note that only eleven cases of this nature occurred out of a whole regiment, nearly all using the same rations; furthermore, this curry powder was also on issue to other operational units in Malaya. This discrepancy can be explained by several reasons. Firstly, 22 S.A.S. Regiment is peculiar in that it remains in the jungle on operations for periods of up to three months at a time; other units only remain in the jungle, fed by 24-hour rations, for far shorter periods. Moreover, the men of 22 S.A.S. Regiment have found it more satisfactory, when living in the jungle, to live as the local inhabitants and limit their diet to one very large rice curry meal per day, interspaced perhaps with two small snacks of tea or soup and biscuits. The cumulative effect of consuming daily subtoxic doses of *Illicium religiosum* over a long period cannot be overlooked. Secondly, not all soldiers have a liking for curry and some ate their meat unflavoured with curry powder. All those who suffered from convulsions, however, had taken curry powder. Lastly, the amount of star anise added to curry powder is small, and inadequate mixing may have led to only certain portions of the powder containing the toxic compound.

## SUMMARY

An outbreak of food poisoning amongst the troops of 22nd Special Air Service Regiment is described. The histories of the men affected were similar in that each became unconscious and exhibited convulsive movements of the limbs. The cause of this intoxication was ascribed by laboratory tests to poisoning with the fruit of *Illicium religiosum*—Japanese star anise—which was incorporated in the curry powder on issue to these troops.

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## IMPETIGO

## A SUGGESTED RÉGIME TO DECREASE ITS ASSESSED MORBIDITY

BY

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DURING the last twelve months the clinical impression has steadily grown that the period of unfitness for normal duties, in cases of impetigo, is unreasonably long. In view of this it was felt that a factual assessment of the problem was worth undertaking.

Seventy-seven consecutive cases of impetigo have been qualitatively assessed from the point of view of actual length of morbidity. The cases have all been taken from the period 1954-5 and have been in no way selected, except in as much as certain cases have had to be excluded due to inadequacy of the case note details, as regards certain time intervals. The cases have been analysed basically from three points of view :

- (1) Duration of incapacity prior to hospitalization ;
- (2) Duration of hospitalization ;
- (3) Duration of hospitalization in relation to the therapy employed.



As a matter of interest, the length of morbidity of 57 cases of pneumonia, over a like period, has been estimated for comparison. Again, the cases are consecutive to avoid bias and all have shown radiological confirmation of the clinical diagnosis.

It was found that the 57 cases of pneumonia revealed an average time of hospitalization of 16.5 days and an average time of convalescence, prior to resumption of normal duties, of 11 days. Thus the average total time, from onset of illness to resumption of normal duties, was 27.5 days. The 77 cases of impetigo are tabulated below in Fig. 1, and when analysed reveal a corresponding time of 13.5 days.

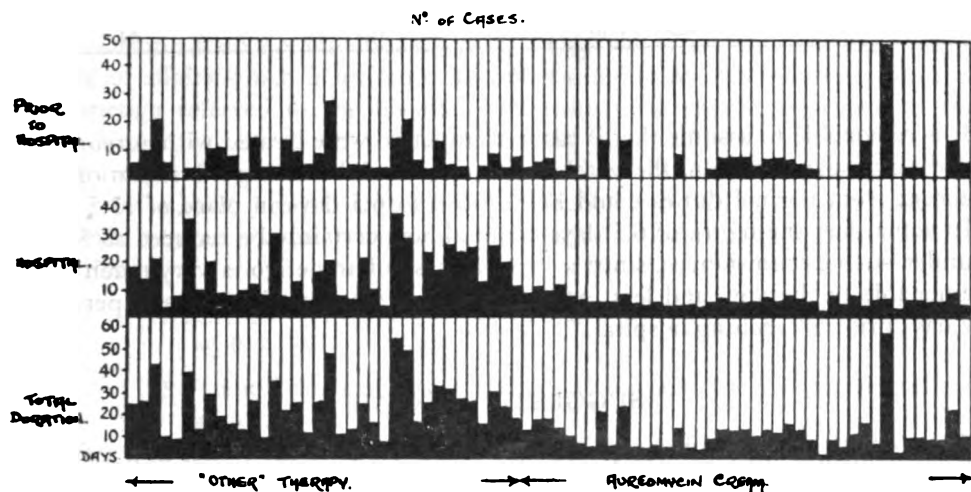


Fig. 1

However, on further breaking down the cases of impetigo, certain significant and disquieting differences are discovered. Thus, if types of therapy employed, in cases of impetigo, are taken into account, it is seen that of 36 cases treated by means other than aureomycin cream, the duration, from onset to resuming normal duties, averages 23.5 days, *i.e.* virtually the time taken to cure a case of pneumonia! On the other hand, of 41 cases treated with aureomycin cream, the similar time interval averages 11.25 days—almost exactly half the time taken with alternative therapeutic measures.

Fig. 2 below shows a graphic comparison of the varying time intervals according to the therapy employed.

It is also evident, on examination of the case records, that the average delay involved, between onset of the rash and admission to hospital, is 7 days. Thus, whereas the over-all average total duration in 77 cases is 13.5 days, it is obvious that even this figure is only due to the comparatively short duration of cases treated with aureomycin. Cases treated with aureomycin cream have required virtually 0.4 of the hospitalization of cases treated otherwise. The explanation of the apparently long over-all average figure of 13.5 days is to be found in the average of 7 days' delay between onset of the rash and admission to hospital.

Time interval	Therapy	Average duration in days	Number of cases
Onset — return to duty, all cases	Both aureomycin and "other" therapy	13.5	77
Onset — return to duty	"Other" therapy	23.5	36
Onset — return to duty	Aureomycin	11.25	41
Period in hospital	"Other" therapy	16	56
Period in hospital	Aureomycin	6.5	41

FIG. 2

It is reasonable to assume that if cases of impetigo were treated with aureomycin and hospitalization from the *onset of the rash*, then the average duration of time absent from normal duties could be reduced to 6.5 days in place of 13.5 days. In actual fact the figure of 6.5 days could almost certainly be reduced to 5 days under such circumstances, since a "fresh" case of impetigo is very much more amenable to therapy, and less extensive, than a case that has already persisted 7 days prior to reaching hospital.

### SUGGESTED RÉGIME

This is both simple and cheap. One per cent. aureomycin cream in a soft wax base, to allow ease of spread, is applied to affected areas b.d. for 3-5 days. The vast majority of cases are virtually clear in 2-3 days. Only cases of unusually long persistence prior to admission to hospital have required ancillary measures such as starch poultices to remove crust formations.

The prescription employed is given below along with details of its present preparation :

R	Aureomycin	...	...	...	g. 1 (4 capsules)
	Lanette wax	....	...	...	g. 1.5
	Arachis oil	...	...	...	g. 20
	Soft paraffin	...	...	...	g. 20
	Distilled water to	...	...	...	ml. 100

The Lanette wax and soft paraffin are melted together and ml. 30 of distilled water added—the mixture being stirred till cold. The aureomycin is triturated with ml. 20 distilled water and then incorporated in the wax base (cold). Distilled water is then added to ml. 100. The cost of the above is approximately 6s. 5d. for 4 oz. of preparation—*i.e.* sufficient for treatment of a case of impetigo of average severity.

Therapies that have been employed at units, prior to admission to hospital, include the time-honoured remedy of 1 per cent. aqueous Gentian Violet, Ung. Hydrarg. Ammon Dil ; Penicillin, as cream and by injection ; Mag. Sulph.

dressings; *l'eau d'alibour*; Anthisan cream; tar ointments and Lassar's paste. In no case is there evidence of any one or combination of the above giving results in any way comparable to those obtained with 1 per cent. aureomycin cream.

It is appreciated that many cases of impetigo may well be treated *in situ* at the unit, but if this is so, then it means that the above quoted figures are applicable to the worst cases of impetigo (*i.e.* cases that fail to respond to unit-therapy), and if such is the case, then the time comparisons and differences demonstrated become even more significant. Thus, even the lowest estimate of 5 days might be improved upon if all cases were treated promptly with aureomycin cream. To argue that many cases are treated at the unit with success is a fallacy in that such cases remain a source of infection to others if response is not rapid and complete—a state of affairs which is all too uncommon judging by the frequency of cases of impetigo referred to the hospital, following unsuccessful treatment at the unit.

Impetigo remains one of the commonest skin disorders met with in army communities, and it is felt that the present series and findings suggest that the following régime is a means of saving an otherwise large and needless waste of manpower:

- (1) Reference of all cases of impetigo immediately to hospital, F.D.S., M.R.S., or sick bay;
- (2) Prompt therapy with 1 per cent. aureomycin cream as outlined above.

The army is fortunate in having a sufficient number of vacant beds to allow rapid segregation of all cases of impetigo and the initiation of prompt therapy. Such measures as suggested would reduce the time loss involved per case from an average of 13.5 days to 5 days or even less, and this cheaply and easily, with no necessity for any new equipment—surely a worth-while step both from the point of view of discomfiture to the patient and time-loss to the army.

### CONCLUSION

Figures are presented, in relation to a series of 77 consecutive cases of impetigo, to show that the length of morbidity of such cases can be markedly reduced. The time-loss involved is compared to that of 57 consecutive cases of pneumonia.

A régime is suggested whereby the present length of morbidity in impetigo can be reduced from 13.5 days to 5 days, or less (a reduction of approximately 63 per cent.) cheaply and easily.

# BILHARZIASIS AND THE 1st (WEST AFRICAN) BRIGADE

BY

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WITH A FOREWORD BY THE DIRECTOR OF ARMY HEALTH

This most interesting article gives an account of one of the medical mishaps of World War II as seen through a layman's eyes. It is easy to be wise after the event, but the story does emphasize the necessity for military medical officers to cultivate "awareness" of disease, especially when entering new localities. It is essential that when a Public Health Department exists it should be consulted, and when it does not exist, a clinical examination, combined if possible with laboratory examination, should be carried out on samples of the local population. In this case also a search of the lagoon would have revealed a snail known to be a possible carrier of bilharziasis (schistosomiasis) and therefore suspicion should have been aroused.

As regards the infectivity rate, this is probably best estimated on the European figure as the disease is endemic in West Africa and it is probable that many of the West Africans were already infected.

In a memorandum produced by Dr. C. E. Gordon Smith he said that a considerable amount of work had been done in trying to infect both Indian and Malayan snails with *Bilharzia* (*Schistosoma*), but all attempts had been unsuccessful. But from the fact that *Schistosoma mansoni*, carried to America by negro slaves, was able to establish itself permanently in New World snails suggests that the establishment of *Bilharzia* in Indian and Malayan snails might occur, and it would seem that, given a suitable period of time and weight of attack, mutations might arise and a substrain capable of adapting itself to local conditions might become established.

EARLY in 1944 a West African Brigade Group in Nigeria, consisting of between six and seven thousand officers and men and destined to sail in the near future for the war in Burma, contracted bilharziasis.

At the end of 1943 the 82nd West African Division was concentrating, prior to its final training and embarkation, in Southern Nigeria. On information received from its sister division, the 81st already in Burma, the commander of the 82nd ordered his brigade groups out into bush camps where they were to concentrate on training in jungle warfare and watermanship. The commander of the 1st (W.A.) Brigade realized that he could not carry out this directive fully unless he were to find ample water and jungle in close proximity to one another. Consulting his map he saw the large Epe lagoon, which runs from the broad and strongly tidal inlet which is Lagos harbour, eastwards to the mouths of the Niger. It is separated from the sea by a strip of sandy soil about ten miles or less in width. It was about one hundred miles south of his existing location at Ede (not to be confused with Epe), and the march there and back through the bush alone offered excellent facilities for training.

Epe could also be reached by road by means of a somewhat circuitous journey, and the brigadier went off on a close reconnaissance of the area. He decided that Epe was ideal for his purpose—there was plenty of high forest, dense undergrowth, few tracks, some swamps and, above all, the broad blue lagoon, slightly brackish but tideless, ideal for teaching his men watermanship. Moreover, the proximity of the large village of Epe made the hire of boats and canoes a relatively simple matter.

On return to Ede, the brigadier instructed his S.M.O. to have a water reconnaissance carried out in the area, preliminary to allotting camp sites for his

various units. He did not specifically instruct his S.M.O. to examine the water for the presence of *Bilharzia*, for at that time he had no knowledge that the disease occurred nearer to him than the Sweet Water Canal in Egypt. What he did know was that for years previously officers and men, in the course of their annual training in all the West African territories, had been in the habit of wading and swimming in rivers, streams and lakes, apparently with impunity.

The S.M.O. was new to West Africa, but he detailed one of his officers, who in peace had been a member of the West African Medical Services, to carry out the required reconnaissance. This officer on return to Ede advised where water points for drinking water should and should not be erected, and the engineers were ordered to carry out his instructions. There was still no mention of *Bilharzia*.

Now it is an incontrovertible fact that although there was a wealth of instructions issued by both Command and District H.Q. on health in West Africa, no mention whatsoever was made in any of these, whether they were directed to the layman or couched in more technical language for the guidance of medical officers, of the words bilharziasis or schistosomiasis. In one of the more "chatty" pamphlets directed to the British officer and N.C.O. there was, it is true, a passing warning against rash bathing in rivers, but from its context one could only draw the conclusion that bathing in obviously dirty water was not to be recommended. This lack of "*Bilharzia* awareness" must be realized because it goes all the way to explain not only why the whole brigade group had to be treated but also why the disease took so long to diagnose.

Whilst the troops were still arriving in their camp sites and constructing their shelters, the brigadier, as was his wont, used informally to visit the various units and talk to the C.O. and others. At one battalion he met the R.M.O., a newcomer to West Africa, who in the course of conversation expressed his doubts about the suitability of Epe as a training camp and specifically mentioned *Bilharzia*. Alarmed, the brigadier set off at once to consult his S.M.O., who, not unnaturally, expressed annoyance that a R.M.O., unfamiliar with the country, should voice his frightening views to the brigadier and, to prove his contention, produced a R.A.M.C. manual, turned to the chapter on bilharziasis, and pointed out that the map accompanying it showed that Southern Nigeria was not marked as being infected with the disease. The camp was therefore allowed to continue with its programme of work which catered for intensive swimming, rafting, canoeing, etc., all designed to teach the brigade to surmount without difficulty the innumerable water obstacles of the Arakan in Burma.

The camp was from time to time visited by various senior medical and other officers from Command and Divisional H.Q., who were much impressed by the realistic training being carried out. There was no more mention of *Bilharzia*. Here it may be said that the brigade group contained more than a dozen medical officers and also a hygiene section, but they all eventually had to be treated for the disease.

The duration of the camp was to be three months. After a few weeks a certain R.E.M.E. major was evacuated sick to one of the military hospitals. He was followed by a steady, but as yet unalarming, trickle of European officers

and N.C.Os. whose complaint seemed to baffle diagnosis. Their symptoms were a feeling of lethargy, of being off-colour, and they had slight temperatures. After treatment, some returned to Epe, others were sent to the hill station at Jos for a week or two to recuperate from what came to be called, in the absence of a better term, "Epe fever." Meanwhile training continued and at length the brigade marched back through the bush to Ede, carrying out an exercise *en route*. While this was in progress, and almost exactly six weeks after the R.E.M.E. major had reported sick, the disease was diagnosed as bilharziasis and the full horror of its implications burst upon the startled Command.

On return of the brigade to Ede, every individual who had been to Epe had his stool and urine tested. This required considerable organization, but the examination was carried through. Whereas a large percentage was found to be positively infected, others showed no trace of the disease. Recourse was then had to the investigation of eosinophilia and it was revealed that the cell count of the majority of those who had so far appeared to be uninfected reached a high figure. Most admitted to lassitude and a general feeling of being unwell, though they could seldom give a clearer account of their symptoms.

The decision, and it required boldness, was then taken by the Consultant at West Africa Command H.Q. to treat for bilharziasis every person who had been in the camp at Epe. The first brigade to leave West Africa for Burma was already embarking and the afflicted brigade was due to go next. Its place had to be taken by the third brigade to allow time for the necessary treatment. As the position was now one of extreme urgency, it was decided that every officer and man should be given nine injections of stibophen, in the buttocks. As available stocks of this drug, hurriedly sent out from the U.K., were insufficient for the numbers involved, one battalion was selected for treatment with tartar emetic. This had its usual reaction of causing immediate vomiting in many of those so treated, and it is not possible now to say without more research, which is probably impossible, which drug was the more effective as a cure.

The mass hospitalization of so many European officers and N.C.Os. and of African troops itself presented no small problem, but one of the greatest was the maintenance of morale amongst the European element in particular. Few of those undergoing treatment were ill enough to remain quiescent in bed all day, and the most alarming stories about the disease and its effects were eagerly disseminated and devoured. The brigadier, himself a patient, sought to combat this state of affairs by forbidding any discussions of the disease and by organizing daily meetings at which the European patients would talk to the others for half an hour on any subject the speaker chose. These varied as widely as the pre-war occupations of the patients and provided all with new topics of conversation and new ideas as to how life is lived. They did much to maintain the morale of the patients. During this period several tests for the presence of *Bilharzia* in the water at Epe were made, and not only were all the conditions necessary for the evolution of the parasite present in the water but the water itself was found to be heavily infected.

On discharge from hospital, the inoculations were followed up by further

stool and urine tests, as a result of which appreciable numbers were still found to be positive and were readmitted to hospital. The loss of these highly trained personnel, especially of experienced British officers and N.C.Os., was extremely serious from the point of view of the brigade's efficiency, but in the event, the reinforcements, mostly straight out from the U.K., proved of high quality when they took the field.

The follow-up was by no means discontinued when at last the brigade embarked for Burma. On board ship, the various medical officers continued their tests, as a result of which still more individuals, and especially Europeans, again proved positive. This posed a remarkably difficult problem for the health authorities in India, where many other unpleasant diseases flourished but not bilharziasis. The type of snail which the *Bilharzia* parasite must find as a host during its cycle of growth is there in quantity, but so far the disease itself had not occurred. However, the brigade eventually rejoined its division at Chas, near Ranchi, where the other two brigades and divisional troops were already undergoing tests for bilharziasis. Some extraordinary results were obtained—*e.g.*, one officer, not of the brigade at Epe, had only twice bathed in West Africa and then in a private swimming pool, yet he was found to be infected. The Epe brigade had once more to be tested *en masse*, and again a number of all ranks were found to be positive and were lost to their units. As far as the H.Q. of the 1st (West African) Brigade was concerned, the medical authorities were eventually satisfied that none of the remaining personnel were suspect except the intelligence officer and the brigadier himself. These two were therefore required for another week to fill a test-tube with their urine each morning on awakening. The I.O. was positive and had to go. The brigadier, however, who had never been found positive, evolved a plan of mild deception which might or might not have mystified the doctors but which allowed him to take his brigade to Burma. He is still enjoying rude health. His plan was to drink a quart of water each night before going to bed at about 10 or 10.30 p.m. This necessitated his rising at about midnight to get rid of the excess fluid in his body. Before returning to bed he drank another quart of water. This process was repeated at about 2.30 a.m. and again before 5 a.m. As a result of this vast quantity of water passing through his body his urine in the morning when he finally rose at about 7 a.m. was almost crystal clear. He confessed afterwards in Burma that he used to wonder for how long his subterfuge would work, but though his new S.M.O. told him that his specimens were so abnormal as to arouse considerable suspicion, his bluff was never called.

It is not the author's intention in this article to apportion blame to anybody. His intention is solely to describe an event, of which he had first-hand knowledge, impartially, in the hope that it may be of help in avoiding similar catastrophes in future.

To conclude, it can be said that, thanks to the unremitting efforts of the medical officers concerned, bilharziasis was not introduced into either India or Burma. A much greater tragedy than the infection of a brigade group, some of whose members became seriously ill, was thereby avoided.



## Obituary

LIONEL ERNEST HOWARD WHITBY, Kt.,  
C.V.O., M.C., M.A., M.D., F.R.C.P., Hon.D.Sc.(Toronto),  
Hon.LL.D.(Glasg.), Hon.M.D.(Louvain), D.P.H.

THE facilities provided today by the National Blood Transfusion Service make it difficult to appreciate the trouble a transfusion entailed less than twenty-five years ago. Probably the greatest single factor responsible for the change was the Army Transfusion Service, developed during the last war.

The inspiration and organizing genius behind this pioneer service, which has been taken as a pattern by so many others since, was Brigadier Sir Lionel Whitby, whose death occurred on November 24th, 1956, after an operation, at the age of 61. By his death the Army has lost one of its most eminent Honorary Consultants and a staunch friend.

Lionel Ernest Howard Whitby was born on May 8th, 1895, and was educated at Bromsgrove School and Downing College, Cambridge. He had won an open scholarship but before taking it up, joined the Royal Fusiliers on the outbreak of the First World War. The following year he was commissioned in the Royal West Kent Regiment and in 1917 was awarded the M.C. for gallantry at Passchendaele. In 1918, when a machine-gun officer with the rank of Major, he was severely wounded and had a leg amputated near the hip. After his recovery he studied medicine at Cambridge and at the Middlesex Hospital where he was a scholar and a prizeman, qualifying in 1923. The way in which he mastered his grave physical handicap at this time will long remain an inspiration to others. Adapting his career to suit his disability, he was appointed Assistant Pathologist in the Bland Sutton Institute of Pathology and soon came to be recognized as one of the leading clinical pathologists in London. He was among those who attended King George V in 1929.

Although much in demand as a consultant, he found time at this period for teaching and research and wrote a number of well-known textbooks including *Medical Bacteriology* (1928) and (jointly with Dr. C. J. C. Britton) the volume "that elevated hæmatology from a superstition to a science"—*Disorders of the Blood* (1935). In 1936, Whitby was quick to realize the potentialities of the sulphonamide drugs and was able to establish on a firm basis, the efficacy of sulphapyridine in the treatment of pneumococcal pneumonia and the importance of continuous therapy.

At the outbreak of the Second World War, Whitby, then a Colonel in the Territorial Army, was invited to organize the Transfusion Service for the British Army and he established its headquarters at the Army Blood Supply Depot at Bristol. This was to provide blood and blood derivatives such as dried and wet plasma and transfusion equipment to the forces at home and overseas and to train officers and men in transfusion duties. He undertook this task with characteristic energy and resource and accomplished it with conspicuous success. He gathered around him a team of workers whom he fired with his enthusiasm and whose efforts he directed with great efficiency and tact. The



THE LATE SIR LIONEL WHITEY, C.V.O., M.C.



Army Blood Supply Depot was a complex unit comprising R.A.M.C., R.A.S.C., R.E., A.T.S., V.A.D., F.A.N.Y., and British Red Cross and St. John Ambulance personnel. These he welded into a most efficient and happy whole. Members of the Army Transfusion Service took an immense pride in their allegiance to Whitby and regarded themselves first and foremost as "Whitby's men."

Whitby realized at once the value of the pioneer work of Greaves at Cambridge on the freeze-drying of plasma and serum and a large plant was set up near Bristol to dry plasma for the Army. He also saw that the supply of a vital fluid such as blood required its own distribution organization in the field, with trained men to handle transfusion supplies at all levels. The development of the Base and Field Transfusion Units was the result, and he worked out the details of personnel and equipment which have stood the test of time.

In addition to the productive side of the work, he directed research on the optimal treatment of plasma for long storage and perfected the organization of bleeding teams for the mass collection of blood. His achievement in this field was summed up in the *History of the Second World War—Surgery* (1953), "One outstanding reason for the greatly improved results of treatment of casualties in the war of 1939-45 was the fact that the restoration of the general condition of the wounded man was made possible by the ready availability of blood (or its derivatives) which could be transferred into the circulation of the patient."

In 1945 he became Regius Professor of Physic in the University of Cambridge. Two years later, he was elected to the mastership of Downing College and from 1951 to 1953 he was Vice-Chancellor of the University.

Sir Lionel Whitby was a man of endearing charm with a delightful and impish sense of humour. His unaffected manner, unchanged by the honours which came to him, and his cordial friendliness, soon put people at their ease. His mind was orderly and intensely practical and he was able quickly to strip a problem to its essentials. This made him an excellent teacher, author and counsellor, and an invaluable member of any committee on which he served. No matter how great the responsibilities he carried or how busy he was, he always appeared cheerful and unruffled and glad to attend to the many problems brought to him by his colleagues.

With these qualities, and his attainments as a physician and pathologist, it was inevitable that he should become an international figure in medicine, and he was much sought after as a visiting professor and lecturer and as an officer of international societies and other bodies.

Although primarily a clinical pathologist, Whitby was always proud of the uniform he wore and set a high example of soldierly bearing and immaculate turn-out and indeed it has been well said that he was "the complete Army doctor." After the war he maintained the happiest associations with the Army Medical Department as Honorary Consultant in Hæmatology, and undertook advanced training of specialists in this branch.

We extend our deep sympathy to Lady Whitby, who as a Major in the R.A.M.C. had worked hard by her husband's side and to their children, one of whom is serving in the Corps today.

## *Book Reviews*

**THE STORY OF THE GUARDS ARMoured DIVISION.** By Captain The Earl of Rosse, *M.B.E.*, and Colonel E. R. Hill, *D.S.O.* London : Geoffrey Bles. 1956. Pp. 320. Illustrated. 25s.

The spectacular achievements of Hitler's Panzer Divisions in 1940 encouraged military opinion of that time to believe that armour, not infantry, would be the basic and most versatile arm of the future. This belief was no doubt the main reason for converting so many superb infantry battalions of the Brigade of Guards to an armoured role.

The authors have written a vivid account of the Guards Armoured Division's share in the campaign for North-West Europe. It is a tale of heroism and success, modestly told, and demonstrates the true adaptability of guardsmen to the task in hand. It cannot fail to inspire all who read it.

There are two glimpses, tantalizing because so brief, of the part played by regimental medical personnel and the medical services : "The medical officer in charge, Captain H. A. Ripman, came near to achieving miracles under almost continuous shell fire"; and "Lance-Sergeant Radcliffe, Medical Sergeant of the 2nd Battalion Irish Guards, a very gallant man who had been responsible for saving many lives in past actions, was killed."

General Allan Adair commanded the Division during most of its training and all its fighting existence. All who were fortunate enough to serve under him will be delighted to read (on p. 303) the tribute paid to him by Field-Marshal Montgomery.

T. M. R. A.

**MODERN OPERATIVE SURGERY.** Edited by the late G. Grey Turner, *F.R.C.S.*, and Lambert Charles Rodgers, *F.R.C.S.*, with a Foreword by Sir Gordon Gordon-Taylor, *K.B.E.* Vol. II. 4th Edition. London : Cassell & Co., Ltd. 1956. Pp. 1383+xii. Illustrated. 75s.

It is not possible to read such a work from cover to cover and review it, nor would it be fair to do so. Most surgeons will have read previous editions completely and in due course this new edition will be so read. The new edition reveals the same high standard we have come to associate with this work. Descriptions of operations are clear and practical hints abound. As before, it should find a place among the books of every surgeon and post-graduate student of surgery.

A. G. D. W.

**PRACTICAL UROLOGY.** By Alex E. Roche, *M.D.*, *F.R.C.S.* London : H. K. Lewis & Co., Ltd. 1956. Pp. 258+xii. Illustrated. 35s.

This unusual book is particularly attractive and instructive not only to the urologist but also to the general surgeon. A series of the author's own cases

are presented in an interesting way. Problems are set for the reader and he may well attempt to solve them before studying the answers. Mistakes and difficulties are frankly discussed, and the comment at the end of each case is both practical and instructive.

A. G. D. W.

A TEXTBOOK OF PSYCHIATRY. By Sir David Henderson, M.D., and the late R. D. Gillespie, with the assistance of Ivor R. C. Batchelor, F.R.C.P. 8th Edition. London : Oxford University Press. 1956. Pp. 746+xii. 35s.

Having reviewed three consecutive editions of this internationally recognized textbook of the Edinburgh School of Psychiatry, I can add little to earlier commendations. The book maintains its high standards of clear writing and thoughtful revision, and the influence of the new collaborator, Dr. I. R. C. Batchelor, is noticed in the fresh and interesting material relating to ætiology and sociological problems. The chapters dealing with epilepsy and with the paranoia group of disorders have been rewritten. A helpful attempt has been made to clarify various fields by discarding the diagnostic concepts of paranoid schizophrenia and paraphrenia, and by placing less emphasis on the significance of cardiazol and electronarcosis in treatment.

Although perhaps a little too compact for leisure reading, this book remains a well-tested, valuable and reliable exposition of orthodox British psychological medicine.

H. P.

PSYCHIATRY AND RELIGION. M.D. International Symposia No. 3. New York : M.D. Publications Inc. 1956. Pp. 62. Not priced.

It has long been generally recognized that sincere belief in any acceptable ethical code can be of therapeutic value to an individual exposed to psychological stress. This comprehensive symposium includes articles on psycho-analysis, sociology, anthropology, the concepts of God, and the personal needs of the individual in their relation to the meaning and function of religion. For those doctors who believe that a large number of psychiatric problems are fundamentally religious in nature, and that the ideals and aims of religion and psychotherapy are similar, this is an interesting and informative publication.

H. P.

THE BROMPTON HOSPITAL REPORTS. Vol. XXII. Aldershot : Gale and Polden. 1956. Pp. 325+ix. Illustrated. 15s.

This collection of papers by well-known authorities on thoracic and cardiovascular disease appears annually and now includes papers not only from the Brompton but from other chest centres as well.

This year there are some twenty papers covering many aspects of thoracic and cardio-vascular disease, including "An appreciation of Mitral Stenosis" (Paul Wood), "Benign Tumours of the Lung" (Sir Clement Price Thomas)

and an excellent series of papers by various authorities on chronic bronchitis. Regarding the latter, it is significant that this hitherto neglected disease, which we now know to be one of the commonest causes of mortality and morbidity, is now receiving the attention it deserves.

In a paper by Howard Nicholson the value of artificial pneumothorax is well discussed, the point being made that the indications for this procedure are now very few and far between although there are still occasions when it can prove of undoubted value.

Although all but two of the papers had previously appeared in various medical journals, it is pleasing to see them collected annually under one cover. This volume will prove of particular interest to those specializing in thoracic or cardiovascular disease, but the general physician will nevertheless find much of absorbing interest.

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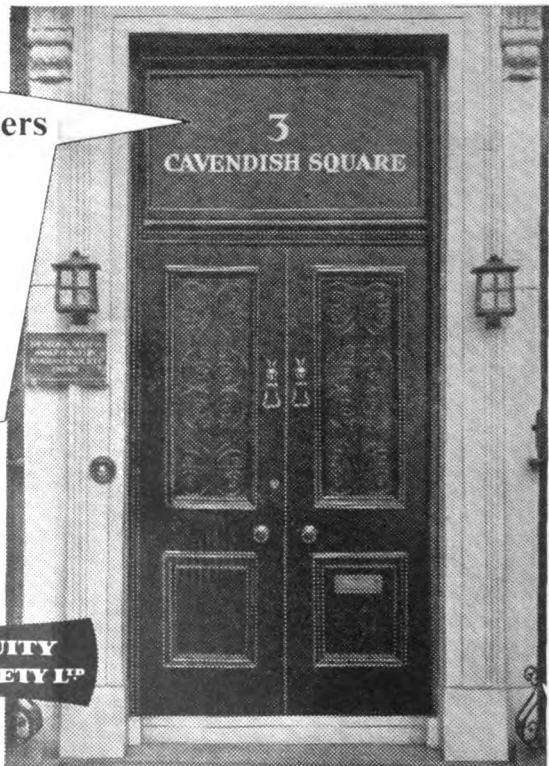
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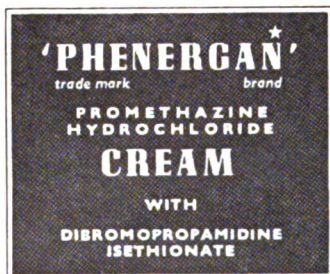
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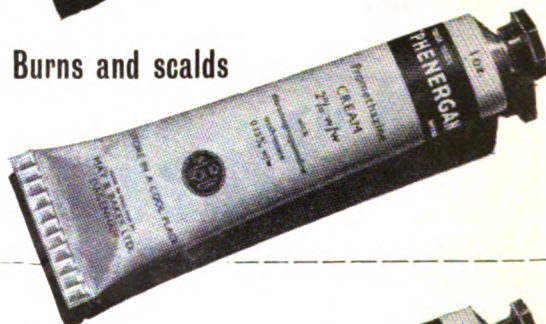
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# **Journal** of the **Royal Army Medical Corps**

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## **AN EPIDEMIOLOGICAL STUDY OF RHEUMATIC FEVER IN THE ARMY IN 1953**

BY

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AND

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### **INTRODUCTION**

THE origin of this investigation was an observation made in 1953 that rheumatic fever in the army appeared to have increased in this country and the year 1953 has been taken as the focus of this inquiry. Rheumatic fever is a serious disease in any year and responsible for a fair degree of wastage in terms of days of sickness, even though the case incidence is not great (Report on the Health of the Army, 1949-50, 1953). In fact inception rates have been low since the last war, averaging about half that of the inter-war years. These annual rates of one or two per thousand are the residue of a problem that produced a rate of 2.5 per cent in the army a century ago.

The epidemiology of the disease is usually confined to children (Hewitt & Stewart, 1952), and the present investigation has no exact parallel in civilian experience. These authors discuss notifications of initial attacks only, in the

age group 5 to 14 years, and use a definition of rheumatic fever which is probably not comparable with ours, and again is different from that used in the Medical Research Council Trial of A.C.T.H. and Cortisone (1955), where it was admitted that diagnostic criteria must be arbitrary. Yet another definition was referred to by Wood (1950), who claimed that approximately 5 per cent of the population have acute or sub-acute rheumatism before they are twenty years old. This would require an average annual incidence of initial attacks alone of 3 per thousand.

The present study is an assessment of rheumatic fever in the army, and the aspects discussed include the seasonal distribution, the incidence of carditis, the effects of age and service, and the influence of locality and the size of garrison.

### METHODS

There are two sources of information on army morbidity, the more prompt being the monthly returns of sickness and the more detailed the actual case records on which most of this paper is based. They differ to some extent, and the former is used chiefly for the purpose of historical comparison, as the standard means of showing time trends. From it has been shown the incidence at home and overseas and the seasonal pattern, both of rheumatic fever and of scarlet fever.

The effects of age and service have been determined from the case records, and a special joint analysis of the numbers at risk has enabled an estimate to be given of the independent effects of these highly correlated factors. The case records also yielded information about the garrison areas in the United Kingdom, and these were related to garrison size. The differences between corps were examined in relation to the element of National Service men in the corps.

The detailed diagnoses in the case records were summarized according to the *Manual of the International Statistical Classification of Diseases* (1948), and the features of the two years 1952 and 1953 compared for evidence of an increase in carditis as well as of incidence. It must be understood that no criterion was used for the inclusion of a case other than that rheumatic fever was the firm diagnosis made by the medical officer and shown on the in-patient record which was received when the case was complete.

### RESULTS

A full table of admission rates is not given here, but the data are readily obtainable from Annual Reports on the Health of the Army, and a summary since 1921 will appear in the Report for 1955. Briefly one can say that the United Kingdom rate is higher than the overseas rate, and that between the wars it averaged 2 per thousand strength every year, and after the Second World War, 1 per thousand. The rate in 1953 was only high in the post-war context, being less than 2 per thousand, and subsequent years have returned to a lower rate.



*Age*

Rheumatic fever has its greatest incidence among children, and in army surveys one looks to find a concentration among the younger age groups ; this is shown clearly in Table 1 which gives the army admission rates by age groups for the United Kingdom.

Table 1. *Admissions for rheumatic fever by age groups—rates per thousand (U.K.)*

Year	Age last birthday (years)							
	19 and under	20-24	25-29	30-34	35-39	40-44	45 and over	All ages
1951	1.5	1.0	0.5	0.5	Nil	0.2	Nil	1.1
1952	1.3	0.6	0.3	0.3	0.3	0.2	Nil	0.9
1953	2.6	1.0	0.3	0.3	0.6	0.3	Nil	1.6

The youngest age group in 1953, which governed the high rate for that year, is compounded of a rate of 3.9 for those aged 18 and 1.5 for those aged 19. Several investigations of this type have made it clear that the age effect as such may be only part of the explanation, and that one must seek for the independent effect of length of service, more particularly of the early months. It will be shown that even if we restrict comparisons to the first six months of service only, the effect of age remains apparent.

*Length of service*

It is difficult to obtain the numbers at risk for differing periods of service, and virtually impossible (to date) to do so at specified ages. The object is to isolate these two factors, which are in a high degree correlated ; that is to say, longer service generally is associated with greater age. As it happens, we are able to turn to account a validation of army medical records carried out in 1955, in which age and length of service were specially investigated, and a random sample was analysed to give the required breakdown. In detail, the numbers would not be appropriate to 1953 where we are examining rheumatic fever, but in broad groups it is probably accurate enough. Table 2 gives approximate rates for the whole army.

Table 2. *Admissions for rheumatic fever in 1953 by age and service jointly—global rates per thousand*

Age	Length of service (months)				
	0-5	6-11	12-17	18-23	24 and over
19 and under	3.3	1.9	1.0	1.2	Nil
20 and over	1.9	1.0	0.6	0.4	0.2

Only now as the result of this analysis by age and service jointly is it safe to say that at every stage of service there is an age effect, and also that for a

particular age group the early stages of service show more cases. There remains one major factor that affects the rates, namely service abroad, and this could lower the rates for the longer periods of service ; indeed it could explain the slightly higher rate for service just short of two years, since there is a return to this country of National Service men prior to their release from the army. The effect here, however, is problematical owing to the uncertainty about the numbers at risk, and could have arisen from a changing age structure between 1953 when the cases occurred, and 1955 when the numbers at risk were sampled. The first six months of service are almost certain to be spent in the United Kingdom and in this group there is no doubt about the effect of age. Closer study of the numbers for each month indicates that admissions most commonly occur during the third month of service. These are shown in Table 3 for National Service men only, since it is reasonable to suppose that there are equal numbers at risk for each of the months.

Table 3. *Admissions for rheumatic fever in the United Kingdom of National Service men in 1953—number of cases*

Length of service	0	1	2	3	4	5	completed months
International Code Number :							
400 Rheumatic fever without carditis	12	14	44	27	13	16	
401 Rheumatic fever with carditis	3	3	9	7	7	7	
Total	15	17	53	34	20	23	

After this initial period when the individual has become accustomed to his new environment the risk appears to diminish, and is limited in a way that can only apply to the Services, for serious cases are invalidated and therefore cannot recur during service. This liability to recurrence is well known, and in fact an examination of 318 of the medical records of cases of rheumatic fever in 1953 revealed 85 with a previous history of the disease. The majority were only brought to light after admission to hospital, but 31 (10 per cent) had been known at the time of the initial medical examination on registering for service. This is a far higher proportion than generally occurs among entrants to the Services. Two men were found with a history of rheumatic fever in a series of 250 entrants. This is a reasonable reflection of the prevalence in the civilian population, although lower than the estimate of Wood (1950) which included sub-acute rheumatism. The policy of rejecting all recruits with a past history of rheumatic fever from the army would, of course, affect a much larger number than might succumb to the disease.

#### *The influence of locality*

Rheumatic fever among soldiers has always been higher in the United Kingdom than elsewhere. Although partly explained by the early months of the recruit training, there seems to be a climatic influence, with possibly a renewed

liability to contract the disease when the soldier returns to serve his last few weeks in this country. The effect is slight enough, with a post-war average admission rate for the United Kingdom of 1.1 per thousand, as compared with a global rate of 0.8 per thousand.

In addition, there is a tendency to exclude soldiers of low medical category from overseas posting. It is interesting to examine the localities at home where cases occur, but there is the difficulty of determining the numbers at risk. Only Scotland lends itself easily to separate consideration, and whereas between the wars the average rate there was higher, it is now no longer so ; in the year 1953, it did not contribute to the specially high rate in the United Kingdom. Cases in that year were distributed among the usual garrison areas, being most common in Aldershot, Catterick and Oswestry, where the admission rates were approximately 3.9, 2.2 and 6.9 per thousand respectively. Except for Catterick, these rates were significantly higher than for the whole country. There was no evidence of an explosive outbreak, and the incidence corresponded to the usual seasonal distribution as shown in Table 8 and Figure 1.

### *Size of Garrison*

Each of the places named in the previous section is a large garrison area, but it would be obviously wrong to base an argument on them since they were selected for having the greatest number of cases in the first place. On the other hand, we can classify all garrisons according to their size and work out admission rates in each size group as in Table 4, and we find thereby that the rate increases with the increasing size of the garrison. (This is an average result ; there is great variability between individual garrisons.)

Table 4. *Rheumatic fever in United Kingdom garrisons, 1953*

Strength of garrison	Cases	Admission rate per thousand
0-1,000	43	0.6
1,000-2,000	72	1.5
2,000-4,000	90	1.8
4,000 and over	100	2.4
Location not known	34	

That the mere size of garrison influences the situation is an intriguing possibility, but there are more specious explanations owing to the uneven composition of the troops—for example, the concentration of recruits in particular areas.

### *Comparison of corps*

In all comparisons such as the one between garrisons, one must be watchful for a differing composition of the population at risk. Supposing we look at the differences between corps, we observe (Table 5) that the Royal Army Medical Corps, the Army Catering Corps and the Royal Pioneer Corps all had a high incidence, with rates over twice the average, while the Royal Armoured Corps had



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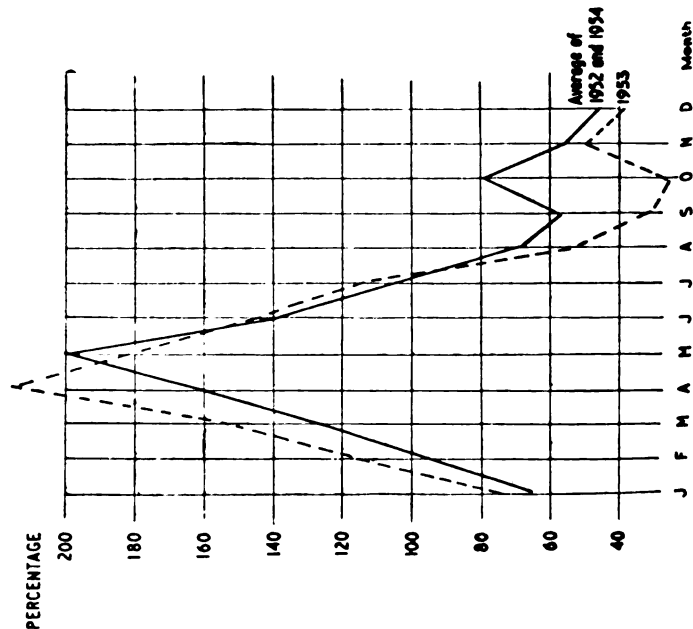


Fig. 1.

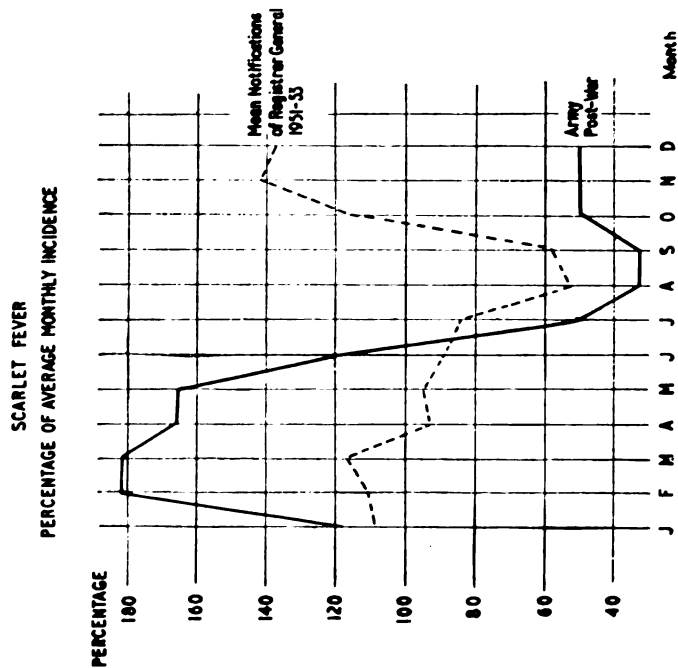


Fig. 2

less than half. But at the same time, the proportion of National Service men in these corps followed the same pattern and perhaps accounted for it; age alone might supply a sufficient answer.

Table 5. *Global rates per 1,000 for certain corps in 1953 and ratio of National Service men to Regulars*

	Rheumatic fever	Ratio N.S./Reg.
Royal Armoured Corps	0.4	0.4
Royal Army Medical Corps	2.5	2.2
Royal Pioneer Corps	2.7	5.4
Army Catering Corps	2.6	2.1

The factor of age would also largely account for a lower incidence among officers, since few are in the most susceptible group, but after allowing for this there remains some evidence of a difference.

#### *Severity of disease*

Although deaths are rarely recorded as an immediate consequence of rheumatic fever in soldiers, it is evidence of the seriousness of the disease that 85 per cent of the admissions for 1953 were eventually invalided out of the army. Another aspect of its severity is the length of time spent under medical care, which is second only to tuberculosis among all diseases. The average for 1953 was nineteen weeks, and although individual variations are rather large, there seems to have been a lengthening trend in time since 1950 when the average stay under medical care was fourteen weeks. There was no apparent difference in 1953 in the average stay when carditis was present. This was a complication frequently encountered and Table 6 shows its extent. As the definition is rather arbitrary, it should be stated that the criterion was the final diagnosis as entered on the case history by the medical officer, supplemented by a cursory examination of the notes by the coder. It is certain that other standards would have yielded a greater crop of complications. Also the coding was spread over two years, during which standards could change considerably. Actual numbers are given for the United Kingdom according to the *Manual of the International Statistical Classification of Diseases* (1948).

The percentage with diagnosis code number 401 in 1952 was 13.7, and in 1953 was 24.2, a rise which was statistically significant (at the 5 per cent significance level). One of the cases of chorea in 1952 had heart involvement, but this does not affect the significance of the comparison. About a quarter of the cases with heart involvement were specifically allocated to the pericarditis or endocarditis groups, in equal numbers.

The detailed diagnoses were examined for each group in 1953, and it appeared at first glance that the incidence of heart involvement increased with age, namely that a higher proportion of code number 401 was found in the older groups; this is contrary to what is normally expected, and in fact is not sufficiently

Table 6. *Number of cases of rheumatic fever admitted in the United Kingdom: detailed classification*

International Code Number		1952	1953
400	Rheumatic fever without mention of heart involvement	144	256
401	Rheumatic fever with heart involvement :		
	Code	1952	1953
	401.0 Active rheumatic pericarditis ...	4	9
	401.1 Active rheumatic endocarditis ...	3	11
	401.2 Active rheumatic myocarditis ...	—	2
	401.3 Active rheumatic fever with other and multiple types of heart involvement ...	17	60
402	Chorea	24 7	82 1
	Total ...	175	339

marked to be statistically significant. (At the higher ages, one or two of the cases with heart involvement had a brief period only of medical treatment, and they may have been suffering from late effects of an earlier attack of rheumatic fever). A group of particular interest, including the high number of admissions at about three months' service, had less than 20 per cent with heart involvement. Table 7 shows the change from 1952 to 1953 in the United Kingdom.

Table 7. *Number of cases of rheumatic fever, with and without carditis, admitted in the United Kingdom*

Year :	1952			1953		
International Code Number :	400 Without carditis	401 With carditis		400 Without carditis	401 With carditis	
Age						
19	101	16	13.7%	198	57	22.4%
20 - 24	35	5	12.5%	49	20	29.0%
25 - 29	4	0	27.3%	3	1	35.7%
30 - 34	2	1		2	1	
35 - 39	2	1		3	2	
40 -	0	1		1	1	
Total ...	144	24	14.3%	256	82	24.3%

There was a significant increase in the percentage of cases with heart involvement in 1953 up to the age of 25, in addition to the increase in the absolute rate.

#### *Seasonal distribution (United Kingdom)*

The increased incidence in 1953 can be narrowed down to a shorter period of time, namely in the first half of the year. The usual season of high incidence in the army is in the few months from March onwards, in this particular year culminating in April and May (Table 8).

Table 8. *Admissions of rheumatic fever in the United Kingdom in 1953 by month of admission*

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
21	33	43	61	51	41	33	16	9	7	13	11

These admissions are plotted as percentages of the average in Fig. 1 and compared with the similar curve for the years before and after. Comparative seasonal trends in civilian life are not available, but it is possible to make a comparison in the case of scarlet fever which is known to have a streptococcal causal agent, and which has a seasonal pattern in the army similar to that of rheumatic fever. The post-war seasonal trend in the army is plotted in Fig. 2, showing a maximum between February and May, perhaps slightly earlier and less acute than that for rheumatic fever. On the same figure are plotted the civilian notifications from 1951 to 1953 which tell another story, the notifications being highest in the last quarter of the year. These are, of course, mainly young children, and one can only suppose that either the disease is acquired differently, or that there is some connection with the reassembly of schools for the academic year and the new pupils. In the army there is no similar change of exposure at a particular time of the year when an abnormal influx is experienced, since intakes occur regularly at fortnightly intervals throughout the year. It should be added that scarlet fever in the army has fallen steadily ever since the war, the rate in 1953 remaining low.

### CONCLUSIONS

In comparison with the past, rheumatic fever in the army is now a much reduced disease, but it is a severe illness involving on the average a hospital stay of four to five months and likely to lead to invaliding from the army. It has the capacity to double its incidence in an unfavourable year, and at the same time to display a greater degree of heart involvement.

The incidence is greatest among young soldiers, especially in the first months of service and among those with a history of rheumatic fever. Altogether, a quarter of the cases in 1953 had such a history. The variation in attack rates between corps is at least partly explained by the differing proportions of National Service men as compared with regular soldiers, resulting in a different age and service structure. The concentration of recruits in particular training areas may in a similar way influence the comparison between garrisons of different sizes, in which a gradient is shown to exist from the largest garrisons, with a high rate, down to the smallest garrison with only a quarter of the incidence.

Changes occurred from one year to another in the proportion of cases with carditis, which amounted to one in four of the cases in 1953. There is scope for variation as a result of the system for collecting the data: numerous medical officers have initiated the records over a period of time (two years) and each uses a clinical definition of the disease, and the coding for machine analysis is per-

formed over a similar period of time. But these are not all disadvantages even in seeking comparison with other investigations ; they are conditions more easily repeated than, for example, a series by a single investigator.

The seasonal maximum is in April and May, when twice the average monthly incidence is experienced. There is no reason to doubt that this is the "natural" course of the disease from the epidemiological point of view, since the intake of recruits is spread evenly throughout the year. Among civilians the course may be distorted because of the academic year ; this is demonstrable in scarlet fever, which has a seasonal pattern similar to rheumatic fever.

#### SUMMARY

Rheumatic fever in the army is a severe illness requiring prolonged treatment, and is sometimes a recurrent attack with origins in childhood ; it has a seasonal distribution with a maximum in the spring. The incidence in 1953 was exceptionally high by post-war standards, the level now (1956) being generally well below the inter-war experience. The heart is involved in many cases, and in the year of high incidence (1953) the number with carditis increased even as a proportion of all cases. The problem affects the young soldier especially in the early months of service in this country, and seems to be located primarily in the larger garrisons where he is likely to be serving.

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## THE TOXICITY OF SCREENING SMOKES

BY

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SCREENING smokes, properly used, are perfectly safe. Some irritation of the throat and chest may be caused, but a properly designed smoke screen will rarely produce ill-effects from any but very prolonged or frequently repeated exposures. These chemical smokes may, however, be harmful if high concentrations are inhaled for more than brief periods, so that dangers can arise from their misuse or the accidental ignition in enclosed spaces, such as dug-outs, buildings, or tunnels. Hardly a year goes by without such an accident occurring, and the diagnosis and treatment of the casualties always seem to present difficulties to the medical officers concerned.

After a recent series of cases about which advice was sought it seemed both opportune and desirable to summarise, for the guidance of medical officers, the relevant experimental and clinical facts on the toxicity of the common screening smokes.

All chemical smoke mixtures can be respiratory irritants and therefore their main toxic effect is one of damage to the respiratory system. However, they do vary in their irritancy and therefore in the danger they present.

*HCE-Smoke mixture* contains equal quantities of hexachlorethane (HCE) and zinc oxide with 10 per cent calcium silicide. On ignition, a dense white smoke is produced and the possible products of combustion are zinc chloride, carbon monoxide, carbon dioxide, phosgene, hydrocarbons and chlorinated hydrocarbons. Chemical analysis of the smoke cloud, produced in an enclosed gas chamber, has shown that the carbon monoxide concentration does not exceed 0.04 per cent, that only traces of phosgene (less than 15 mg./m<sup>3</sup>) are present, and that the only constituent of the smoke likely to be harmful is zinc chloride. On an average, the efficiency of the smoke generators is such that for every 100 g. mixture used, a little over 40 g. of zinc chloride is released.

When inhaled, zinc chloride behaves as a corrosive irritant and animal experiments have shown that it will produce a severe tracheobronchitis and intense pulmonary congestion and œdema. Guinea-pigs, which are susceptible to bronchospasm, may die rapidly from this and at autopsy the lungs are markedly emphysematous. The dosage of zinc chloride required to produce death in animals is, however, fairly large. Thus the LC<sub>50</sub> for mice (*i.e.* the dosage, expressed as the product of the concentration and time of exposure to kill 50 per cent of the mice) has been estimated as 11,800 mg. min./m<sup>3</sup>. However, the dosage had to be reduced to 2,000 mg. min./m<sup>3</sup> or less before no macroscopic or histological sign of lung damage was seen.

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\* Present address : Department of Pharmacology, University of Toronto, Canada.

Therefore, the highest safe dosage has been taken to be 2,000 mg.min./m<sup>3</sup>, and this could be for a single exposure or a series of repeated minor exposures over a period of ten days.

Some indication of what this safety dosage means in terms of safety distances from the smoke source can be given. It has been calculated that, in a good area smoke screen at night, under suitable meteorological conditions, the concentration of zinc chloride at 200 yd. from the source would be about 85 mg./m<sup>3</sup> (therefore the subject can safely stay there a maximum of 24 minutes), and at 1,000 yd. the concentration would be about 13 mg./m<sup>3</sup> (and the maximum safety time of exposure, therefore, is 2½ hours). In efficient flank screening by day and under suitable meteorological conditions, the zinc chloride concentration at 100 yd. from the source would be 47 mg./m<sup>3</sup> (safety time 43 minutes) and at 1,000 yd. would be 0.9 mg./m<sup>3</sup> (safety time 37 hours).

Some minor irritation may be noticed by men working in these smoke screens. Thus, in a concentration of 120 mg./m<sup>3</sup> zinc chloride from HCE-mixture, volunteers complained of irritation of the nose, throat and chest, with cough and nausea, after 2 minutes. At 80 mg./m<sup>3</sup> for 2 minutes, the majority had slight nausea, one or two coughed and all noticed the smell of the smoke. However, men working in the field for 30 minutes at 200 yd. from the source, only felt a slight burning sensation in the chest and the smoke cloud was not intolerable.

The lethal dosage for man is, of course, not known, but, on the basis of our animal experiments, it is considered to be probably greater than 50,000 mg.min./m<sup>3</sup> of zinc chloride. Such a dosage would be achieved by one generator in a 100 cu.ft. room in 2-3 minutes.

It is, in fact, usually following exposure in small, enclosed spaces, *e.g.* in trenches, dug-outs, tunnels and between decks in ships, that the majority of the reported casualties and deaths from HCE smoke have occurred. Occasionally men have been affected in the open but then usually not seriously.

Affected men usually complain of pain in the chest and abdomen, difficulty in breathing and nausea. They cough continuously and there may be vomiting. Lachrymation and conjunctivitis may be seen. Dyspnœa and cyanosis become progressively more marked and the clinical picture varies with the concentration of the smoke.

In exceedingly high concentrations, such as have resulted from the spontaneous ignition of smoke generators in a tunnel, death may occur rapidly from asphyxia due to œdema of the larynx and spasm of the glottis. In lesser but still very high concentrations death may occur in a few hours from severe hæmorrhagic ulceration and excoriation of the upper respiratory tract.

With smaller but still high dosage the cause of death is usually pulmonary œdema, with less severe damage to the upper respiratory tract. Death in these cases usually occurs within 24 to 48 hours. Those dying later show, at autopsy, some damage to the bronchial mucosa, moderate pulmonary œdema and a superimposed bronchopneumonia.

Animal experiments suggest that the injection of BAL will aid the excretion



of zinc and so protect against zinc chloride poisoning. The respirator gives complete protection against HCE smoke.

**Chlorsulphonic Acid Smoke (C.S.A.).** The mixture used is 50/50 w/w of chlorsulphonic acid ( $\text{SO}_2(\text{OH})\text{Cl}$ ) and Sulphur trioxide ( $\text{SO}_3$ ). It gives a screening cloud consisting largely of sulphuric acid droplets, with little chlorine or hydrochloric acid. The chemical concentration of an effective screen, in terms of sulphur trioxide content, is probably not greater than 30 mg./m<sup>3</sup>.

Cameron (1954) has reported experiments in which he exposed a variety of animal species—monkey, goat, rabbit, guinea-pig, rat and mouse—to maintained concentrations (30 and 60 mg./m<sup>3</sup> in terms of  $\text{SO}_3$  content) for 6 hours a day over periods of 7 to 14 days. Only one species, the guinea-pig, proved susceptible, dying from bronchial spasm, pulmonary œdema, and acute bronchitis. He concluded that the chief risk when human beings are exposed to chlorsulphonic acid smokes in these concentrations will be found in persons susceptible to bronchial spasm; that is, those who suffer from asthma or allied conditions. Persons not subject to pulmonary disturbances should suffer no ill-effects.

The concentrations used in the above experiments would probably be similar to those experienced 500 yd. astern of the point of emission with a head wind of 5 m.p.h. and a ship steaming at 5-10 knots. These concentrations, although not permanently harmful, are intensely irritating. A "burning" or "tight" sensation in the throat and chest with coughing is experienced by most subjects, although many become accustomed to the smoke and can then remain in the cloud. With higher concentrations the symptoms are more distressing and no one would voluntarily stay in those denser smokes without adjusting his respirator, which gives complete protection. The severity of response does, however, vary from subject to subject. Thus, in one series of experiments, involving exposures of 2 minutes duration, the concentration (expressed as C.S.A.) had to be raised to 855 mg./m<sup>3</sup> before wearing of respirators was enforced in all exercising subjects and to 1,220 mg./m<sup>3</sup> before all the subjects at rest had to don their respirators. At these concentrations eye irritation, burning, sensations in the throat and chest, coughing, profuse salivation and distressing nausea were the symptoms produced. Some subjects actually experienced explosive coughing and were unable to adjust their facepieces. This could be dangerous in certain circumstances since prolonged and unprotected exposure to such high concentrations could undoubtedly cause severe corrosive and irritative lesions in the respiratory tract. Normally, however, the irritation caused by this smoke would warn men to seek the protection of their respirators or to move out of the cloud.

**Titanium tetrachloride** is another corrosive substance which can be used for producing smoke screens. In general it is less toxic than C.S.A. but more irritant than HCE. The pathological effects produced in animals which have died from the inhalation of large quantities of this substance are similar to those described for HCE and C.S.A.

Sometimes the question is asked as to the danger of grazing stock on land contaminated with titanium tetrachloride. The latter discolours green leaves and stock will usually avoid these if non-contaminated land is available. However,

cows, sheep, goats and horses can be fed on hay from a contaminated area and they will suffer no ill-effects. The titanium is not absorbed from the gastrointestinal tract but passes harmlessly through to be excreted in the fæces.

*White phosphorus.* This may present a double hazard to troops since it has been used to produce screening smokes and also as an incendiary agent. The smoke may produce irritation of the throat and can induce coughing but, compared with C.S.A., it is not unduly harassing. Experiments have shown that a concentration of 700 mg./m<sup>3</sup> is required before the effects compel men doing moderate work to adjust their respirators; 1,770 mg./m<sup>3</sup> is needed to harass men similarly at rest. Even with concentrations as high as 3,600 mg./m<sup>3</sup> it is impossible to produce explosive coughing and so hinder the adjustment of facepieces.

Personnel may be burnt when ignited lumps of phosphorus fall on them. On burning there is immediate pain and rapid vesication occurs; erythema usually fades within 24 hours. In order to be certain of producing vesication of the skin through two layers of clothing in tight contact with the skin a particle of phosphorus weighing about 100 mg. is required unless, of course, the immediate pain and smoke and flames produced cause the person to take quick remedial action. For third degree burns particles more than 1 g. in weight are needed, and a similar sized particle is required to burn through damp clothing.

These phosphorus burns closely resemble thermal burns in their pathological history. There is little reason to anticipate absorption of phosphorus, with the production of general systemic phosphorus poisoning, since only minute amounts of free phosphorus persist for a short period in the burnt areas and the chances of absorption of such phosphorus from the tissues are slight. Oily material may, however, lead to absorption and should be avoided in all treatments.

For first-aid treatment a copper sulphate-soft soap ointment is useful. It is easy to apply, soothing, rapidly puts out the flame and renders the phosphorus particles readily visible.

Perhaps it should also be mentioned that land which has been contaminated by phosphorus-containing missiles may be dangerous to grazing livestock. Small pellets of phosphorus can be driven into tufts of grass so that, by the exclusion of air, combustion may not be complete. This phosphorus if eaten will, of course, produce toxic effects.

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# THE DEVELOPMENT AND ORGANISATION OF THE ARMY BLOOD BANK IN CYPRUS, AUGUST, 1955—AUGUST, 1956

BY

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BEFORE August, 1955, there was no organised military blood bank in Cyprus. The B.M.H. Cyprus in Nicosia was a hospital with 200 equipped beds, which were increased in July, 1955, to 270, but the number of patients in the hospital averaged only 80-90. It was therefore thought unnecessary to maintain a blood bank in the hospital.

During this time a donor panel of troops in the island was maintained ranging from 100 to 200 donors. The approximate number of troops on the island in August, 1955, was 8,000-9,000. A blood bank was maintained at the civilian hospital in Nicosia, but this was not used by the army although when it was first formed military donors were often bled.

Two factors led to the necessity for keeping an army blood bank. The first was the move of troops to Cyprus from the Suez Canal Zone base and the second was the internal security situation as a result of terrorist activity on the island. From the 28th August, 1955, a small bank of 4 pints of blood was kept in a 3 cubic foot domestic refrigerator. At first 2 pints of Group O Rhesus positive and 2 pints of Group A Rh positive blood were held, but this was soon modified to 3 pints of Group O Rh positive and 1 pint of Group A Rh positive. The demand for blood in the B.M.H. was still not very great. During August, 1955, only 3 pints of blood were used in the hospital.

## THE DONOR PANEL

By the end of September, 1955, there were 320 donors on the panel, which was then in the process of being reorganised. The names were kept on a card index system, each donor having a card giving his number, rank, name, unit, location, blood group and "R.H.E." date.

The panel was divided into the units outside Nicosia which provided 150 donors, the units within Nicosia which provided 121 donors, and the local hospital panel of 42 donors. The units outside Nicosia were used for routine stocking of the blood bank, and they required twenty-four hours' notice to get donors up to the hospital. The units within Nicosia were reserved for emergencies

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when the bank was exhausted. The B.M.H. panel was reserved for acute emergencies, especially those occurring in the middle of the night.

Each donor not already holding a National Blood Transfusion Service card was ABO grouped and Rhesus grouped with anti-D serum. All D negative donors were regrouped with anti C plus D and anti E sera. They were all Kahn tested. Rh negative donors were only accepted if shown to be phenotype *cde*. By the end of July, 1956, the number of donors on the panel was 1,636, of which 786 were located outside Nicosia, 682 within Nicosia, and 168 were on the local hospital panel.

### THE FIRST THREE-MONTH PERIOD

During the first month of the life of the bank, 8 pints of blood were used, mainly for maternity and routine surgical cases. It was not until the end of October, 1955, that severe casualties, needing massive transfusion, occurred. These consisted of two groups—road accidents, and bomb and gunshot injuries as a result of terrorist activities.

The first severe and fatal terrorist casualty occurred at Paphos, 100 miles from Nicosia, on 27th October, 1955, and 5 pints of blood were flown out by helicopter from the B.M.H. Nicosia immediately. At this time it was considered necessary to increase the bank's holding to 5 pints, 4 pints of Group O Rh positive and 1 pint of Group A Rh positive. The donor panel was also increased to 500 donors, with an emphasis on units stationed in and around Nicosia. This was made easier by the increased concentration of troops on the island.

During the third month of the life of the bank 29 pints of blood were issued. By this time terrorist activity was starting seriously.

### SITE AND STAFF

The bank was held in the laboratory of the B.M.H. Nicosia, originally in a main room but later in a side room away from the main laboratory. The original refrigerator was augmented by a further 4.7 cubic foot refrigerator and the temperature was controlled at 4° C., using maximum and minimum thermometers and keeping a daily record of the readings.

Donors were originally bled in the wards, but later two beds were placed in a room in the laboratory for this purpose. The bank was run by the hospital pathologist, who had a staff of three technicians for all duties. In October two more technicians were posted from the Central Medical Laboratory in Fayid to assist in increasing the donor panel.

At the end of November, 1955, the Central Medical Laboratory was transferred from Fayid into the premises occupied by the laboratory of the B.M.H. Nicosia, absorbing its staff to form the new Command Medical Laboratory. The bank then came under the direct supervision of the Assistant Director of Pathology, M.E.L.F. At this time one technician was employed full time on serology and blood bank duties; occasionally, when the pressure of work increased, he was assisted by a further technician.

### BLOOD HELD

After February, 1956, it was considered necessary to keep 10-15 pints of Group O Rh positive and 3 pints of Group A Rh positive blood in the bank to meet emergencies. Before a week-end the bank was generally built up to 20 pints of O Rh positive and 5 of A Rh positive. If Rh negative blood was needed, donors had to be summoned from the immediate neighbourhood. The Rh negative panel was considered to be too small to allow the routine keeping of Rh negative blood in the bank. A similar procedure was adopted for Group AB and B patients.

As far as possible blood of homologous ABO group was issued. However, in an emergency if homologous blood was not available Group O blood was issued until donors of the homologous group could be obtained and bled. Rh positive blood was never issued to Rh negative recipients except in very extreme emergencies. There were always Rh negative donors standing by in the hospital who could be bled on the spot and meet the needs of the case until further donors could be obtained from the immediate vicinity. As far as possible blood was always issued after cross-matching. Uncross-matched blood had only to be issued on a small number of occasions, as it took no longer than twenty minutes to perform a rapid tube-centrifuge test in saline and albumen.

### MASSIVE TRANSFUSIONS

On a number of isolated occasions it had been found necessary to issue large amounts of blood over a short period, for severely injured patients. Over a twenty-four-hour period in April, 48 donors were bled and 42 pints of blood were issued. In another period of seven hours, 42 donors had to be bled for cases admitted when a bomb had been thrown into a vehicle.

To meet this type of situation a "Crash emergency" system was organised. The three pathologists on the establishment of the Command Medical Laboratory were alerted. Two organised and bled the donors while the third supervised the cross-matching of blood. One technician stayed by the bank, two assisted with the bleeding of donors, another assisted in the marshalling of donors and the supply of refreshment. Two technicians were employed in checking the group and cross-matching of blood. On these occasions all other laboratory activities temporarily ceased. Of 100 patients transfused during the year, 26 needed over 5 pints of blood, 11 over 10 pints and 5 had 20 pints or over. During the whole period there were no reactions attributable to the transfusion of incompatible blood.

### ORGANISATION OF DONORS

Two methods were used to organise new donors. In the first, direct contact was made between the pathologist and the unit medical officer to appeal for new donors within his unit. In the second, the District A.D.M.S. was approached and a District routine order was published explaining the need for donors. In

the latter case, the O.C. unit would then approach the laboratory, giving a nominal roll of donors in his unit.

In both cases arrangements were then made for a pathologist to visit the unit and take samples of blood for grouping and Kahn testing from those prospective donors who did not already hold National Blood Transfusion Service cards. It was found impracticable to take more than 100 samples at a time in one of these sessions, due to the clerical errors that might occur with larger groups. A lot of work would have been saved if every soldier had been grouped by the National Blood Transfusion Service during preliminary training at his regimental or corps depot in the United Kingdom.

Owing to the fluid state of personnel due to posting and National Service release, the panel had to be reviewed every month and the cards of those who had left the island discarded. Efforts to recruit new donors therefore had to be continuous and a target of 150 new donors a month maintained, to keep the panel at 10 per cent of the population available.

#### WASTAGE

There was an inevitable wastage of blood owing to the time expiry factor. Three weeks was regarded as the optimum life of the blood. Approximately 420 ml. was taken into 120 ml. of 1.66 per cent disodium citrate with 2.5 per cent glucose in distilled water (A.C.D.). After three weeks the blood was kept for a further week in a separate refrigerator when it was available for "in and out" transfusions. If not used at the end of this week it was given to the bacteriology department for making media. The wastage was never reduced below 10 per cent and was due to clinicians expecting to use more of the rarer group blood than they did, and the estimated monthly use of blood falling below that expected.

Table 1. *Monthly issue of blood by the bank in pints*

August, 1955	...	...	...	...	...	...	...	3
September	...	...	...	...	...	...	...	8
October	...	...	...	...	...	...	...	16
November	...	...	...	...	...	...	...	24
December	...	...	...	...	...	...	...	29
January, 1956	...	...	...	...	...	...	...	16
February	...	...	...	...	...	...	...	54
March	...	...	...	...	...	...	...	52
April	...	...	...	...	...	...	...	54
May	...	...	...	...	...	...	...	125
June	...	...	...	...	...	...	...	90
July	...	...	...	...	...	...	...	35
Total	...	...	...	...	...	...	...	506

#### ACKNOWLEDGMENT

We wish to thank Lieut.-Colonel Mary Munro, R.A.M.C., for her constant help and advice.

## EXERCISE "MEDICAL DEUCALION" D.G.A.M.S. ANNUAL EXERCISE, 1956

BY

MAJOR-GENERAL F. M. RICHARDSON, D.S.O., O.B.E., M.D.

"There are in my army two transport mules which have served through twenty campaigns—and they are still mules."—FREDERICK THE GREAT.

WITH these words a soldier who boldly escaped from the ankylosing influence of military convention rebuked officers, who in their thought about warfare of the future relied too heavily on the validity of previous experience. I used the quotation first in public when opening the Mytchett demonstrations in 1952 at which, by the order of Sir Richard Gale, then the Director-General of Military Training, we showed large gatherings of senior officers how troops in the field might be protected against the effects of nuclear weapons. For some time after that our late Director-General, Sir Frederick Harris, used to call me "Frederick's Mule," and I believe that I avoided this as a permanent nickname only because he must have realized in time that it might seem to imply that I did Frederick's donkey-work. I have used the quotation many times since then in urging young soldiers in B.A.O.R. to bring their unfossilised minds to bear on the problems of the nuclear battlefield without too much heed to the Dunkirk drones and the Bocage bores.

In the Director-General's opening address to "Deucalion," as he introduced us to the new team at Mytchett, could be heard the same appeal to youth, and he had assembled a beauty chorus of young Q.A.R.A.N.C. officers in the gallery, and later deployed an exceptional number of very young-looking R.A.M.C. majors. They say that it is an early sign of old age when you think how young the policemen look these days—this comes just before conductresses begin to help you off buses. But I am not sure where to place the stage at which you say, as a friend said to me at Mytchett, "How young Colonel Commandants are nowadays !" He was not, of course, punning in this allusion to the upstanding youthful figure of General Tom Young, our Representative Colonel Commandant, who attended the exercise.

With all this accent on youth one might have thought that the Editor would have found a cub-reporter to take over this account of the exercise, but, as he said to me : "Well, you know all that rubbish of yours about Napoleon and Wellington is the only thing which sells my paper."\* I may have slightly misrepresented him, but someone must read this nonsense, for one or two have

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\* A libellous distortion of an innocent comment.—Ed.



asked me how, in view of the fact that dystrophia adiposo-genitalis is commonly associated with sterility, can one account for the King of Rome? Well, I would remind them that the diagnosis was not mine but that of a medical Lieutenant-General of the French army, and that I have heard that guides at the Schönbrunn palace in Vienna used to relate that it was common gossip in Vienna that whoever was the father of that child it was not Napoleon.

Wellington was not much addicted to gossip—just as well, perhaps, since he was evidently not averse to an occasional affair himself, though they were never so blatant as poor Lord Nelson's famous one—but he did produce a titbit one night at a small dinner party at Strathfieldsaye, when, in talking of various royalties, and, as Lord Stanhope says, "rambling from subject to subject we came at length to the ex-Empress Maria Louisa. The Duke said that the first time he had seen her was during the Congress of Vienna in 1815, when he went to pay his respects to her at Schönbrunn; but owing to the state of things in France, he did not often, of course, find himself in her society. It is a very curious thing, he added, that she afterwards said to someone: 'The Duke of Wellington little knows the service he has done me by winning the battle of Waterloo! The fact is, she was then with child by Neipperg—whom she afterwards married; and if Napoleon had prevailed she would have had to return to him in that state' (2).

But now, if I am to avoid another acid footnote by the Editor, I must get down to the exercise, and I would say at once that if you still need a good reason why I should not be asked to report next year's exercise it could be that, like the publicity agents for Hollywood's ever-increasingly-colossal productions, I am running out of adjectives. For without a doubt "Deucalion" fully endorsed the tradition that each D.G.'s exercise must be better than ever before, and richly earned our unstinted praise for the boldness of its conception and for the elegance of its production. If your knowledge of Greek mythology, like my own, is creaking a bit you will need to be told that Deucalion, son of Prometheus, was in fact the Greek Noah, who built an ark to circumvent Zeus' plan to wipe out the human race. When the floods subsided, realising that he had omitted to embark anyone except himself and his wife Pyrrha, he thought it advisable to seek advice from the gods about his task of repopulating the earth; and was told that he and Pyrrha should cast stones behind them, whereupon those cast by him would become men, and those of Pyrrha, women. Deucalion himself, the presiding genius of the exercise, another triumph of make-up for Captain Critchley, and equipped with a truly magnificent rotund voice, appeared from time to time, and after declaiming some suitable comment on the development of the theme, he invariably took from his wallet a stone, and after regarding it thoughtfully for a time replaced it, and stalked off saying, "Not yet." At his first appearance he reinforced the D.G.'s welcoming remarks by sending to each V.I.P., as a memento of the exercise, a large medallion of Deucalion set in a wooden frame, delivered by the fair hand of a sweet nymph (Patricia Ahern), who was conducted to Generals Burki, Chaudhuri, Gorby, Hall, Hayes, and Brigadier Shier by Mercury in the person of the P.T. Instructor, Lance-Corporal

Fosh, who, despite the Greek origin of our word gymnasium, had insured against wayward displacement of his flowing draperies with more than the conventional figleaf.

In describing "Avernus", I suggested that the soldier of the nuclear age should never have to suffer what our fathers suffered in the First World War (3). Digging and dispersion must inevitably spare us such sights as the battlefield of Talavera, on which, in Sir Arthur Bryant's moving words, "lay thousands of dead and dying, piled in stiff or still faintly stirring hillocks of soiled scarlet and blue"(1). I made no attempt to paint the other side of the picture, passing too lightly over the grim possibility that it will be civilians who must endure the horrors of a future war. Their morale could be powerfully sustained by prompt and effective help from a well-trained military force. The important subject prescribed by the D.G. for examination in his 1956 exercise was how such help could best be given, and how we could plan and train for this task. It is plainly not the D.G.'s intention that his units should simply be handed over to any organisation which might prove to be unable to employ them wisely, so we must know enough about the civil defence organisation to enable us to collaborate in evolving sound plans for developing our maximum potential in dealing with any incident. Beginning therefore at the top, the D.G. had invited General Sir Sidney Kirkman, the Director-General of Civil Defence, to address us, and this was a most interesting and valuable introduction to the problem. Next Lieut.-Colonel Marks spoke about the new experimental field medical organisation, for we were later to see how it might fit into the plan. Those of you who are out of touch with developments in this sphere will be reassured to know that it has never been the D.G.'s intention to push ahead with reshaping our field medical organisation until he is fully satisfied of the soundness of the new fabric. Amongst the patterns produced for his appraisal, when it became his heavy responsibility to equip us for nuclear war, was the so-called "New Look," which we might call a nice Harris tweed with an intricate Crosse-stitch pattern. But just as we may claim that in "Mushroom" we showed a lead in demonstrating how troops might be protected in the field, so in elaborating the "New Look" we were perhaps a step ahead—too far ahead, in fact, because the staff have not even yet determined either the make and shape of the divisions of the future nor the tactics of the nuclear battlefield. So now the D.G.'s aim is to ensure that we build our structure on sound foundations. He is thinking in terms of the bricks of which it will be built—possibly units capable at all levels of caring for some 100 patients. This line of approach might well be compared to that being undertaken in such circles as the Headquarters of the Allied Land Forces of Central Europe, where French staff officers particularly, are elaborating the theory of the "critical mass" in the organisation of all arms for nuclear war. And how glad you die-hards will be to know that he is likely to retain the name of "field ambulance"; though the most reactionary die-hard must admit that the name is worthless unless the new field ambulance can do a job worthy of the great traditions of the old.

Two other very important facets of planning and training dealt with outside the main theme of the exercise were First Aid and Psychological First Aid.

Brigadier Phillipson's valuable talk on the latter subject should be read by everyone in the exercise report. It would be wrong to attempt to make a précis of all the sound advice he contrived to pack into twenty minutes. Captain S. E. Rayner told us of the achievements of the new First Aid Training School, which in its first year has trained for the army 967 first-aid instructors from combatant units—good instructors, too, for 20 were graded outstanding and 216 above average, whilst of those sent to the school 8 per cent were failed. A good start has also been made in the Territorial Army. Captain Rayner's talk included reports which proved that these instructors are actively employed in spreading the teaching throughout the army, and from one personal report we learned that even in peace time lives can be, and have been, saved as a result of this. In an outside demonstration we saw competent first-aid being done by young soldiers who had been trained by regimental instructors.

The exercise theme began to unfold in a discussion in late autumn of 1960 between the D.D.M.S. of the Avalon Command in the U.K., Lieut.-Colonel Hood, and his A.D.M.S., Major Blyth, about how effective aid to civilian casualties could be given by army medical units in the command if the period of international tension then prevailing should culminate in a sudden enemy attack on main centres of population. We in the audience were joined by the Army Commander, Lieut.-Colonel J. E. Miller, who dropped in at the D.D.M.S.'s office and stayed to hear his plans and to ask a few questions. (How young Lieutenant-Generals are these days—and how did the make-up man resist the temptation to plant upon those smooth features an efflorescent moustache of the type which, with memories of a certain A.D.M.S. in "Royal Road," we might call *Phlox drummondii*?) The plan expounded by General Hood aimed at guaranteeing to the Civil Defence organisation all over the U.K. a certain number of beds in places where they would probably be needed, and by locating such hospitals in army barracks to avoid making demands on buildings which might be earmarked for other uses. It was hoped that by selecting four alternative sites suitably spaced round each likely target for attack at least one of these should be suitable, however the fall-out pattern might develop, for the establishment of an emergency hospital of some 1,500 beds, about twenty miles to the windward of whatever should prove to be ground zero. Such hospitals would have to be set up within eight hours of an attack, so careful planning had been undertaken to staff and equip them; and the pre-selected sites for the hospitals, like the target areas they would serve, had been given code names. The staffing of the hospitals was to be by such units or sub-units as could most easily be spared from field formations mobilizing within the command, together with increments from static medical units, which were to consist of detachments of one to three medical officers, three nursing officers, and 30 other ranks, specially trained to staff and equip 100-bed blocks for various types of case. These sub-units and detachments would bring equipment with them, and would hold any necessary extra equipment as a Civil Defence reserve. Further help would be given by the provision of a central sterile supply service from the nearest peace-time military hospital. Ordnance would provide laundry facilities, including washing of surgical

textiles if sterilization proved to be impossible. Royal Engineer assistance of every sort might well be badly needed, and it was felt that amongst the many claims on their time from all sides our first priority might be in connection with water supply.

Our next meeting was with a District A.D.M.S., one of those who would have to mould into an efficient working unit all the bits and pieces raked together by the D.D.M.S. on the day of trial. It was well that he should be a fairly genial and even-tempered officer—Lieut.-Colonel Dick in fact. The army's medical plans seemed to be well laid and in competent hands ; and after lunch we were given a similar insight into the planning and organisation of Civil Defence, in a very interesting presentation by a team from the Army Operational Research Group, led by Mr. Gould and Mr. Smith, who themselves began with a talk on general Civil Defence organisation illustrated by a first-class floor model, which must have made even Mytchett envious. Then followed two playlets. In the first we were present at the dramatic moment when the duty officer at a Civil Defence sub-regional headquarters was aroused to hear of a mega-ton explosion over Birmingham. This playlet was designed to show the state of the city in terms of fire, destruction, and radio-activity, hour by hour after the explosion, and to portray the Civil Defence counter-measures as realistically as possible ; to try to determine the earliest time at which the reality of help, and not its planners' mirage, might first take useful shape. It was an honest and forthright presentation of what might well happen if we should be faced with such a situation to-morrow, and A.O.R.G. deserved the congratulations which they received from all sides. The second playlet was set in an A.D.M.S. office, and A.O.R.G. assumed that our 1960 telephone calls would be complicated by being able to see the caller on a TV screen, and they had provided the A.D.M.S. with one, on which we could see the characteristic silhouettes of those with whom he spoke—the unmistakable D.D.M.S. for example, as solid and dependable as the Rock of Gibraltar, and a well-known figure at Mytchett too, for it was Lieut.-Colonel Hooper. But despite this amusement this last playlet failed to hold my interest. Use of the telephone to heighten excitement or tension is a common dramatic device, and at Mytchett it has been freely used for comic effects. Here its overuse induced boredom, and not benign soporific boredom for it was punctuated by sharp pricks of irritation. I make this comment in the spirit of the notes on A.F.B2078, for confidential reports on majors and above—"Every-one has his weak points as well as his strong ones ; therefore, describe both." An oleaginous stream of praise often fails to impress superior reporting officers, who may in fact be moved to suspect the initiating officer's own judgment. But in revealing weak points one can often see mitigating influences underlying them, and so it is here. I have reason to suspect that Deucalion was sold one of those pups of which wary exercise producers have learned to be very suspicious—the bright idea conceived too late for rehearsal. Of course he did not tell me this himself, so, glancing again at the notes, we can infer that Deucalion is "loyal, and gets results by leadership, not by driving." Already he must suspect that his *grading* will be "above average," or even "outstanding."

So much for Birmingham's H bomb ; and before the blitz got any closer to Mytchett the first day's work ended with a playlet in which we heard discussed such tricky ethical problems as euthanasia and priorities for treatment when one is faced with cases who could live to fight another day, and others who might never be restored to full function or may even be doomed by ionizing radiation. And just before dispersing for the evening we visited a deep shelter constructed in section near the officers' mess. Whilst we were looking at this, a motley crowd of civilians, ranging from infants in carry-cots to old age pensioners, converged upon it and were bedded down by the shelter officer. They had come because an enemy air attack was thought to be imminent, and they had not long to wait, for in less than twelve hours—at 0425 on the 6th October, 1960, in fact—a nuclear bomb explosion just north of Reading was reported. We heard of it next day at breakfast. Some pretty glum looks were exchanged by the curmudgeonly old traditionalists, that is to say by more or less anyone in "flannel," when a wireless musical programme opened up at breakfast ; but it was soon interrupted by an unmistakable B.B.C. announcer with the awful news of the enemy attack, though it was reassuring to realize that, judging by the wind direction, we should be just outside the fall-out area. After this news flash the announcer said we were to have the scherzo from "Frankie the Bagpiper," which proved to be a pretty cacophonous noise. I was assured that it was a genuine excerpt from Weinberger's "*Schwanda der Dudelsackpfeifer*," but could it be that someone was having his leg pulled, and at breakfast too ?—monstrous.

After visiting again the deep shelter, which was some fourteen miles from the edge of the fall-out area, we went back to the gymnasium to hear how the district medical authorities were dealing with the situation. They had decided to open the support hospital in Keogh Barracks, its code name being "Harden"—all the code names were those of R.A.M.C. winners of the V.C. The D.D.M.S. dropped in to be briefed, and the layout was explained to him on a fine model of the barracks, and so we were given a clear exposition of what we would be seeing in the course of the morning's visit to the Harden support hospital, which together with expansion accommodation being prepared at the Cambridge and Connaught Hospitals was to provide the necessary 1,500 beds. This was a most impressive and practical demonstration. Keogh Barracks, which during the night had housed its ordinary occupants, was now a hospital engaged in admitting and treating the casualties with which it was steadily being filled. The casualties came from a filter unit set up by a Medical Staging Unit, at which sorting had been carried out and from which the first priority cases had been sent elsewhere. The task of Harden Hospital was therefore to give any specially urgent treatment, but principally to "support" them for a period of up to eight days until definitive treatment could be arranged for all. Triage having been done elsewhere, the hospital was organised in special sections for the supporting of such types of case as head injuries, burns, fractures, chest and abdominal casualties, thus benefiting by being able to use teams trained to handle special cases. The teams were planned to handle 100 cases—another phase in the search for the medical "critical mass." Although in our normal training it is hardly possible to give

such specialized instruction to large numbers of medical auxiliaries it was clearly shown here how, if our men are soundly trained, the impetus of an emergency could enable them to be organised in a very few days into smoothly working teams capable of a considerable "through-put," to use one of those misshapen monsters recently spawned from the union of zeal for progressive planning and desire to coin expressive phrases. Be sure to read all about this in the report.

There was a tremendous amount to see as our progress round this emergency hospital was kept up to time, and any tendency to linger gossiping with members of our syndicate or with friends met *en route* was checked by the urgent Gs sounded by Bandboys R. Taylor and D. Boone, who I hope were making the most of what may have been the one and only chance in their service of making so many senior officers "jump to it." (If that "D" stands for Daniel, as surely it must, we were perhaps lucky not to be speeded along by shots from an expertly handled frontiersman's musket.) Impressions had to be stored in the mind rather than in a notebook, and for details of the staffing and organisation of Harden hospital I must refer you to the official report which will be a valuable companion to "Bombs on Benghazi" ("Royal Road," 1955). We saw various types of casualty being handled. The F.T.C. had been helped in the masterly casualty faking by teams from 56 (London) Infantry Division, T.A., and 10 (London) General Hospital, T.A.; and 51 General Hospital, A.E.R., helped with the reception and handling of the casualties. Pyjamas were still in use, but I made a note of the exercise A.D.M.S.'s idea of using flannel shirts as a substitute, which struck me as very sensible from the point of view of storage and nursing in field conditions. A well-organised Information Room, in which B.R.C.S. and Order of St. John workers and chaplains were helping, prevented the work of the hospital from being impeded by members of the public. Lieut.-Colonel Johnstone convinced us that the forcing of a high protein diet upon serious casualties within the first fourteen days may be unnecessary and even harmful because the hormonally regulated katabolic phase has not yet been succeeded by the hormonally regulated anabolic phase; but a more direct appeal was made by a "gastric mucosal stimulant" in the form of that experienced high-power demonstrator, Major Harwood, A.C.C., who brought us back to grub, and showed us how his corps could help us to cook and enjoy it. Whilst he spoke his team was building a field oven in which they cooked delicious Welsh rarebit. How I kicked myself for having taken only half a piece as I hurried on, munching happily, to the mobile laundry, where, though no samples were offered, we saw how the R.A.O.C. can help us. In the absence of lifts, casualties were being conveyed to the windows of upper storeys on hoists improvised by the Royal Engineers from such equipment as fork-lift trucks and builders' hoists, whilst equipment was going up on a stacker and bundles of dirty linen were cascading down fire escapes—what a pity we couldn't bring the children. I hope that the model of Harden Hospital, supported by photographs of these equipments and perhaps of some of the wards and departments, will become a standard exhibit at the Field Training Centre.

On the second afternoon we went first to the Royal Aircraft Establishment at

Farnborough where a company of a M.S.U., complete with its equipment, and with attached Q.A.R.A.N.C. personnel, arrived in a Blackburn Beverley aircraft, and made a business-like job of de-planing and moving off the airfield in its waiting vehicles, despite the handicap of the plane's doors jamming. Any impatience which that small hitch might have caused was allayed by an inspired exhibition of helicopter aerobatics by a Westland Widgeon, which the pilot of the Westland Whirlwind, which was also on show, was thoughtful enough not to emulate whilst he was conveying the Colonel Commandant and five other senior "stretcher cases." We also saw the Single and Twin Prestwick Pioneer. I first heard of this wonder aircraft which can spring into the air with a really worthwhile load of casualties in 1953, when Brigadier Elmslie, then D.D.S.T. at the War Office, told us of it at Exercise "Cambyses." Ever since then I have been putting my money on it rather than on the helicopter—so expensive, so difficult to maintain, spending many hours on maintenance for each hour in flight, and so impossible to conceal in the field. What if Westland are developing a beautiful new one which will take some thirty-six stretcher cases? This might be very useful, but in the field, especially in the forward areas, the medical services are not well suited by vehicles or aircraft with a large payload. Other administrative services can offset the inconvenience of the limitation of daylight movement and of all administrative traffic because of enemy air activity, by planning convoys at suitable times and may be helped by increasing payloads, but in our case this might often result in uneconomic loading. The time and nature of the medical task cannot be foretold, and our precious cargo cannot usually be kept waiting. Little and often is what we need. So I was most grateful to "Deucalion" for showing us the Pioneer, and I hope to hear much more of it. At this demonstration I learned the secret of the presence at Mytchett of my old friend Colonel Livingstone Kerr, who retired from the appointment of A.D.M.S. 51 (Highland) Division some time ago. The other senior Territorial delegates from beyond the Tartan Curtain had asked me if his presence might constitute a precedent for other retired Scots A.D.M.Ss. I could only suggest that he was with us in his capacity of Deputy-Lieutenant of the County of Lanark, and perhaps I was not too wide of the mark; for it was his ability to put in a word in the right quarters which helped the D.G., who always seems to know how to get what he wants, to secure these fine Prestwick Pioneers for the demonstration. It was no mean tribute to the quality of the entertainment provided at Mytchett, and to the Territorial spirit, that "Livy" Kerr asked for no reward other than an invitation to the D.G.'s exercise. The exercise report should be consulted for planning figures concerning these aircraft, but some brief particulars can be given here. The Beverley can carry some 12 tons of vehicles, stores, or men, with a range of 1,000 miles. It can take 48 stretchers and 34 sitting cases (preferably not too badly hurt, as they travel in the tail boom) plus 5 attendants. With a load of 60 casualties and 5 attendants the range can be increased to 1,500 miles—*e.g.* a non-stop flight from Malta to the U.K. The Single Pioneer takes one stretcher and two sitting passengers, with a range of 300 miles; and the Twin Pioneer takes nine stretchers, two sitting cases, and a medical orderly; or without



stretchers, 15 sitting patients and a medical orderly ; and it has a range of 400 miles, which can be increased by lightening the load. The Westland Widgeon takes two stretchers and a medical attendant, or four passengers, and the Whirlwind takes six stretchers and a medical attendant, or 8 to 10 passengers, but has a range of only around 200 miles compared to the Widgeon's 260 and the Pioneer's 300 to 400 miles.

Whilst the M.S.U. company which had flown to Farnborough were moving to Aldershot and preparing their emergency hospital, we visited a camp for the homeless organized by the Army School of Health. A great crowd of homeless people were arriving at the Reception Centre, and a B.B.C. man was selecting a cross-section of them to record their experiences for an outdoor broadcast. Mrs. Waites, the wife of Sergeant-Major Waites, R.A.M.C., was the theatrical producer of this dramatic interlude, in which humour and pathos were most acceptably blended, and her own fine acting was ably supported by a cast of soldier actors. Most of us thought that the "man with the mike" was a professional, but he proved to be Corporal Haddon, R.A.M.C. This outdoor broadcast was a telling and lucid way of underlining the varied personal and communal problems which would have to be considered in organising such a camp for the homeless ; and then as we were conducted round the camp we could study the methods by which an infantry unit might handle such a task with help from other arms, such as R.E., R.A.S.C., A.C.C., and of course army health personnel. For me, this ranks as the best demonstration which I have yet seen staged by the Army School of Health.

When we moved on to the site of the emergency hospital the M.S.U. company which we had seen landing at Farnborough had set up a ward for 100 patients, 20 in beds and 80 on stretchers, using the Universal shelter. It had taken over certain casualties which had been left behind when another unit was hurriedly moved. Some of these were too ill to be moved, but fifty were less serious, being all fracture cases in need of plaster. To deal with these Harden Hospital, in response to an urgent request, had sent a plaster team of twelve R.A.M.C. and Q.A.R.A.N.C. student nurses who were allowed just half an hour to complete the task. This we saw them achieve with practised ease, although, as we were told by Lieut.-Colonel Waterston, they had in fact received only some three days' training in the methods which they used. This demonstration illustrated the scope of modern transport aircraft. We were told that two Beverleys can transport three complete M.S.U. companies ; and of course there are many other useful possibilities, since the Beverley can also take lorries loaded with the equipment of companies or sections, and the men could even more conveniently be transported in a Britannia, which takes 100 men. A demonstration by the Cambridge Military Hospital showed us how with good routine various types of case can be treated or supported whilst awaiting definitive treatment, in considerable numbers, with minimum use of staff or waste of time. We saw and heard explained drills for applying skeletal traction for fractures of the lower limb with Steinmann pins (ten patients in half an hour) ; and the admission and treatment with full-length plaster-of-paris leg splints of one hundred cases of

compound fracture of the tibia and fibula (two hours and five minutes). Various aspects of the care of mass casualties were discussed, and I felt glad that Major Downie, who must have a future as a clinical teacher, could be more cheerful this year, for I remembered his tender solicitude last year for that pathetic ward full of girls doomed by an overdose of "R"—a real tear-jerker. Finally the central supply department of the hospital, expanded to cope with mass casualties, was visited. This is emphatically a section of the report which you must all study. There was no faking about the supporting treatment which the staff of the Cambridge Hospital next administered, and without that magnificent tea many of us would have had little spirit for the discussion with which the day's work ended.

At the exercise supper that evening our most senior guests presided at tables decorated with their national flags ; and for me and my contemporaries the time of pre-dinner drinks was a very special occasion, for we drank them with Lieut.-General Chaudhuri, who was in our batch at the Depot, way back in '28. A still more remote link with the past was being celebrated by Lieut.-Generals Burki and Drummond who were fellow-undergraduates at St. Andrew's University—and as that seems to come under the heading of "things which might have been expressed more delicately" I might add that as the evening wore on their undergraduate days did not seem to be so very remote after all. Oh well, perhaps I had better stop trying to take my foot out of it.

The last morning began with a final visit to our friends in the deep shelter whom we saw being released from their long confinement after monitoring teams had decided that a safe escape from the fall-out area was open to them. Their part in the exercise was delightful evidence of the way in which the great occasion of the D.G.'s exercise can touch every inhabitant of Mytchett, in or out of uniform—in fact in or out of "nappies." Then, after the talk by Brigadier Phillipson which I have already mentioned, we saw a playlet which suggested how we might reconcile staffs and commanders to some of the aspects of the proposed new units which especially affect them. This did not quite ring the bell for me. I suppose there *may* be divisional commanders like that, but oh, how I prefer Captain Critchley as a Russian general ! During the general discussion of the exercise Brigadier Officer said that he believed that the new units could have done the job, but he felt that a field ambulance could have done it just as well. He stressed the superiority of a unit under its own commander to the collection of detachments of various units which had formed Harden Hospital. This was an echo of the "meccano-set" criticism made last year by Colonel Meneces, and readers of my last report will be relieved to hear that he was there again with some sage comments, about the importance of communications, and that he had come not from sea-level on Rockall, but from the rarefied, almost stratospheric atmosphere of S.H.A.P.E., where any waves he may be contemplating are not those with which the Inspector of Training is so familiar. I gave a tentative toot on my trumpet at the neighbouring walls of Jericho by suggesting that army health is a sphere in which we have won our battles, having convinced the whole army of its importance, and handed the torch to them in

the concept of Health Discipline. Any failure by commanders to play their part in this can be neutralized by a puff of D.D.T. and a pocketful of sulphasuccidine tablets. As the next war will be a contest of morale—a powerful platitude that—we should transfer our efforts to the spiritual sphere, in which we can make a contribution to the army which might equal all the great achievements of our Corps in hygiene. The discussion was brightened by a small freshet from the reservoir of eloquence and humour which I knew to be dammed up behind the benevolent exterior of Colonel Shaeffer, a prominent surgeon of the United States Army who had come in General Hayes' party from Washington. He has recently covered a great deal of the world with a high-powered team of lecturers on the handling of mass casualties. Anyone who has experienced the stream of Joe Shaeffer's oratory in full spate will know that to offer him five minutes was like trying to confine the mighty Mississippi between the banks of the Basingstoke Canal. I wish that as many of you as possible may yet have the chance of hearing him on his favourite subject.

In an interesting demonstration of new American, British, and French field equipment, including inflatable huts and a variety of cooking and heating equipment, everything looked good and seemed to work well, and with very fresh memories of a family caravan and tenting holiday I longed to "win" the smaller inflatable hut. Unfortunately it is too often a characteristic of these demonstrations that all the fine things are hustled back to Didcot and other hidey-holes and never seen again—by me at any rate. Just as the army, when it introduces new patterns of uniform, gives you and me a reasonable time in which to wear out the old type "in possession," so it seems to need a most inordinately unreasonable span to wear out all the old junk which it holds stored up against the possibility of war. If the medical services are going to have to handle and treat many more casualties spread over a much more extensive and dispersed battlefield with much the same number of men and vehicles as before, then we really do need to be allotted a very high priority in the bidding for genuine light-weight materials. Purely *medical* equipment accounts for only about one-tenth of the load of the field medical services. The rest is G 1098 and all that, and the bulk of it is tentage. The hospital marquee tent weighs  $2\frac{1}{2}$  tons. When the staff of an Evacuation Hospital, which in future may with advantage include many Q.A.R.A.N.C. other ranks, have erected several of these after a long night move, how fresh do you suppose they will feel for their proper job of caring for the casualties? As I have not got an inventive or practical mind, I used to throw out this challenge to the Didcot experts who have that sort of mind. In the 1950s they can do almost anything with plastics. Suits of clothes, fishing rods, and even Trinity House pilot boats can be made from glass fibre. But we are still lugging around heavy stiff canvas and clumsy poles, and I do not exclude the Universal Shelter; and when we have erected these confounded things we set about disguising their outlines with piles of sodden nets and crude garnishing material, which we must also drag around the countryside in vehicles, in the load tables of which no provision is made for the amount of camouflage material which would be needed to make a proper job of concealing the vehicles and the tents and

shelters which they carry. When will the experts give us a lightweight shelter fixed perhaps with wires from trees or light posts, so that it has no outline to be disguised and can fit into various awkward places? What would the Royal Army Ordnance Corps think of us if we asked for transport to take with an expeditionary force going to a tropical country several tons of Jesuit's bark? Of course, I know that the most essential need for the lightweight materials, the tubular aluminium poles and so on, is the construction of the aircraft which will gain for us the air supremacy by which alone we may hope to avoid having too many casualties to handle. But all the same it makes you think.

Back to "Deucalion," which ended with talks on training and Territorial problems by the Inspector of Training and Brigadier Ward, and some remarks by the Chief of Staff of the U.K. Land Forces, Major-General Blacker. During the Director-General's closing address we had the now traditional moment when he thanks the back-room boys who work so hard to make the show go with a swing, and the curtain rises to show a beaming collection of men of the Field Training Centre, under the regimental sergeant major. As a former producer I was especially struck by their noiseless assembly, for I had memories of my anxiety, when we were founding this tradition, of the D.G.'s voice raised to drown the scuffling of army boots on what was then an improvised stage, and even perhaps some throaty whispers from Sergeant-Major Cross—no terminal "E" to distinguish him from our usual principal boy, Major-General Crosse, D.M.S. of a succession of army groups. But anxiety did not press too hard for, with the successful delivery of the exercise conceived by the happy union of several minds, our main task was accomplished. But the birth of an exercise does not end the responsibilities or the hard work of its organizers. Mytchett, the puerperal mother, soon returns to normal life, but if her child is to play his full part in the training of our officers, real hard work has to be put into the preparation of a concise and readable report—the full report to which I have made frequent references in this and previous accounts, from which not only those who attended but many who did not can extract the important lessons. In general there is nothing deadlier than a dead exercise, and if the reports are very bulky documents in which the teaching points are like currants in a N.A.A.F.I. cake—sparsely distributed in a somewhat stodgy matrix—people just will not read them. It takes a great deal of time and care to reduce playlets and demonstrations to précis in which the training lessons are crystallized, but it is well worth while from the point of view of the vast majority of readers, and there won't be any "vast majority" at all if the effort is not made. Copies of the full scripts of playlets can be held at the Field Training School for loan to units who want to use them in their own exercises.

Deucalion himself at his final personal appearance spot-lighted in a most amusing way a serious medical problem of this nuclear age—the need which the incidence of mass casualties might impose upon us to leave much of the first-aid and supporting treatment to medical auxiliaries working under as much direct supervision as the hard pressed doctors can afford them. I have heard Colonel Shaeffer speak of this problem as it touches operative surgery. The specialist

surgeon's knowledge and experience will be so essential for the supervision of scores of less skilled operators who must immediately tackle the cases urgently awaiting operative treatment that he must not get immersed in an operation which may last several hours, during which he could have guided the steps of those dealing with a dozen cases or more—advising here, helping there. "I foresee some pretty ropy resections being done by the dermatologists and the psychiatrists," said the colonel, or words to that effect. So when Deucalion for the last time took the stone from his pouch he pondered whether to create a super-surgeon or two, or a swarm of sub-professional personnel. He plumped for the latter. Over his shoulder went the stone, and out and across the gymnasium pattered the swarm of very small children dressed as surgeons from the cap and mask to the little white rubber boots—with a Pied Piper's little lame boy rather bemused at the rear helped along by pats from the audience. Could they *all* have been Aherns?

All in all this D.G.'s exercise was a sparkling production, and if some of the sparks flew from the grindstone of one with an axe to grind they were sparks well calculated to light the fires of constructive enthusiasm in our minds, for the "New Look" seemed to adapt itself fairly well to duties in aid of the civil power. Those who read my account of "Royal Road" will have guessed that some of us were unimpressed by its advocacy of the "New Look" in its application to the divisional area. This may be only one small part of the problem. An exacerbated threat of casualties must in future fall upon every part of a theatre of war from front to rear. We must get things right from the point of view of the whole theatre. But I believe that those who are the most profoundly disturbed by the implications of the proposal are those with the greatest amount of operational field ambulance experience, or who have had a chance to try it out in manœuvres. Let no one think that their antagonism is parochial or swayed by sentiment. Unless one believes that air forces alone will win or lose any future war and will make it impossible for armies to stir on any road or track, or for light aircraft to venture into the air, then it will be in the divisional area that most of the fighting will take place, apart from airborne and similar incursions into rearward areas. The field ambulance will still be the reception department to the whole evacuation chain, including the medical units affording definitive treatment to the wounded—close medical support for the fighting troops and their often hard-pressed regimental medical officers its most sacred task. **CLOSE MEDICAL SUPPORT**—the slogan deserves block letters, for this close support of R.A.P., where certain other armies keep two doctors, should always be our most pressing anxiety in battle. No one who has seen the horror of R.A.Ps. overwhelmed by casualties or by other disasters which can so suddenly strike them could contemplate any weakening of this link in the chain. The divisional area is the point of honour of our Corps, and incidentally it could be said to be the scene of all the pictures in our V.C. Room of which we are so intensely proud except that of Assistant Surgeon C. M. Douglas in his boat. So perhaps sentiment does come into it after all, but parochialism—never. Our combatant commanders and staffs know well how difficult our task may be and how disastrous the effect on

morale if we should fail in it, and I have yet to hear one of them suggest that we can suffer a cut in the divisional medical services, though many have said that we may need an increase. Manpower must certainly be found to bolster up corps and army medical support, but the suggestion that the divisional area has always been overinsured could never be accepted by anyone who saw fairly heavy casualties, as for example in the Normandy bridgehead. A committee appointed by the D.G. to report on the "New Look" consists of men who had that experience and we may feel complete confidence that they will find the answers. If they do so they will deserve great credit, but the lion's share must go to the originators of the proposals for the boldness of their conceptions which assuredly put the cat among the pigeons, stirring us all to face up realistically to the problems of the future, and focusing the attention of commanders and staffs at all levels upon our difficulties. After all, it is always easier to criticise than to create, as Whistler quite probably told Ruskin, and it certainly calls for less genius. I was at the War Office in the days immediately after "Avernus" when Colonel Crosse was flinging the paint at his earliest canvases, and I am not entirely sorry that I dodged having to share the hard work of the first key plan. It was much easier to be asked to try out the ideas in the field, and if I have been one of the critics I have never withheld my admiration from the creators. I am sure they have given us a stimulus from which something good will result before long.

And so we come to the moment at which I must assess the grading of "Deucalion." How can I fail to be oppressed by a sense of my own inadequacy as I grow increasingly aware of that benignly dignified presence behind my shoulder, his rather heavy breathing, with—yes, I think just a suggestion of nectar, revealing that even the gods are not untouched by concern over our human judgments? Through which lines shall I run my pen—above average, average, below average, or all three? We are nearly all average—some perhaps more average than others—but we take a poor view of the chap who tells us so on paper. So out go the last two. Above average? Well, that is scant praise when I have already said that it is traditional for each D.G.'s exercise to be better than the last, each one inheriting some useful bit of property, a new stage and so on, from its predecessors. I doubt whether this traditional progression can possibly be maintained, short of obtaining a grant from the British Council, sending selected soldiers to the Royal Academy of Dramatic Art, arranging *échanges au pair* with Hollywood, and possibly offering the appointment of Inspector of Training to Mr. Cecil B. de Mille. Above average certainly, but think of some of the high-lights. A.O.R.G.'s fine model; Keogh Barracks ingeniously transformed overnight into Harden Hospital; those lovely Prestwick Pioneers; the outdoor broadcast, and the barrow-boy with his radio-active apples at 2d. extra the pound; Lieut.-Colonel Wheatley's drill for traction with Steinmann pins which really went through; the atomic bomb singeing poor old Deucalion's whiskers on the proscenium. And do not imagine that it was all charades. Think of all the valuable training absorbed by so many officers and men of Regular, A.E.R., and Territorial units in the process of planning, pre-

paring, and staging the exercise for our enjoyment and instruction. Deucalion had every reason to be proud of the men and women he created. Out goes "above average." The only possible grading is "outstanding."

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## HÆMOGLOBIN LEVELS IN RECRUITS AND TRAINED SOLDIERS

BY

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THE results of hæmoglobin surveys using Haldane's method published in Great Britain prior to the last war (Price-Jones, 1931, and Price-Jones, Vaughan & Goddard, 1935), when compared with similar results published in America, indicated that the hæmoglobin content of British males was lower than that of American men. Jenkins & Don (1933) were, however, unable to confirm this impression and the results of their investigations, in which the hæmoglobin was estimated by Van Slyke's apparatus, showed that the values in healthy British and American men did not differ. The apparent discrepancy was resolved by King *et al.* (1947), who proved that the Haldane standard, which had been used in so many British surveys, had a value of 14.8 g. equal to 100 per cent, and not of 13.8 g. as had previously been accepted\*. When the previously published British figures were recalculated on the basis that 100 per cent Haldane equals 14.8 g. it was found that they were then in general agreement with the American values (King *et al.*, 1947).

The confusion which has resulted from the multiplicity of hæmoglobin standards can best be avoided by expressing all results in grammes per 100 ml. This practice has been followed when compiling Table 1, which gives a representative selection of previously published hæmoglobin values for normal males.

During the first half of 1956 we visited a number of military units and carried out a limited hæmoglobin survey, some of the results of which are also included in Table 1.

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\* By recent International agreement, the chemical constituents of hæmoglobin have now been defined in such a way as to make the British Haldane Standard 100% = 14.6 g. Hb/100 ml.—Ed.

## METHOD

Two visits were made to the Guards Depot, Caterham, the first in March, the second in April, 1956. Blood was taken from recruits, both Regular and National Service. Most of these recruits had arrived at the Depot on the day of our visit ; a few had been in the army for several days. All the men had recently been passed as fit for military service. The trained soldiers belonged to a field ambulance comprised of R.A.M.C., R.A.S.C. and A.C.C. personnel. The great majority were medically fit for duty everywhere and their service ranged from 4 months to 4½ years.

Capillary blood was taken between the hours of 2 p.m. and 6 p.m. One pipette, the calibration of which had been checked, was used throughout and all examinations were carried out by the same person. The hæmoglobin was converted to alkaline hæmatin by 0.1 N. sodium hydroxide and estimated in an EEL photo-electric colorimeter, using Gibson and Harrison's (1945) solution as a standard.

## RESULTS

The mean hæmoglobin values and the ranges observed are given in Table 1. Of the 140 recruits examined, 2 (1.4 per cent) had hæmoglobins of under 12 g. per cent and a further 6 had values under 14 g. per cent. There were 13 recruits with 17 g. per cent or more of hæmoglobin. Among the trained soldiers there were none below 12 g. per cent and 2 above 17 g. per cent. Service had little effect on the hæmoglobin level.

Table 1. *Hæmoglobin Values in Adult Males*

Authority	Number	Nationality	Age	Mean in g.	Range in g.	Method
Berry et al. (1949)	147	Cosmo- politan (a)	16-47	16	13.7-18.6	Alkaline Hæmatin
Hamre & Au (1942)	137	Cosmo- politan	16-25	15.1	11.8-17.2	Alkaline Hæmatin
Jenkins & Don (1933)	118	British		15.8	13.8-19.0	Van Slyke
M.R.C. (1945)	849	British	Under 30	15.1		Haldane
Osgood (1935)	259	American	14-30+	15.8	14-18	Osgood and Haskins
Price-Jones (1931)	100	British	av. 27	15.6	14.2-17.2	Haldane
Price-Jones et al. (1935)	90	British	20-42	15.7	13.6-18.0	Haldane
Walters (1934)	100	American	20-30	15.1	12.9-18.7	Acid Hæmatin
Wintrobe (1933)	86	American	Students	16.0	13.9-18.4	Acid Hæmatin
This survey— recruits	140	British	17-29 (b)	15.5	11.1-18.3	Alkaline Hæmatin
This survey— trained soldiers	89	British	18-24	15.3	12.1-17.5	Alkaline Hæmatin
This survey— Total ...	229	British	17-29 (c)	15.4	11.1-18.3	Alkaline Hæmatin

(a) Olympic athletes.

(b) Includes only 2 men over age 22.

(c) Includes only 5 men over age 22.

## DISCUSSION

The mean hæmoglobin level of the 229 soldiers included in this recent survey shows no appreciable change from previously reported values for healthy males. When considering the range of values obtained it must be remembered that the extremes recorded may not in fact represent the true limits of normal, as a few abnormal bloods may inadvertently be included in a survey (Wintrobe, 1933). Leonard (1954) examined 4,221 R.A.F. recruits and found 50 (1.2 per cent) with hæmoglobin values of under 12 g. per cent, which he regarded as indicating undoubted anæmia. By this standard our series of 140 recruits also included 2 cases of anæmia (1.4 per cent). While a hæmoglobin of under 12 g. per cent is usually taken to indicate anæmia in the male, one of only 13.7 g. per cent may be quite consistent with the physical perfection of Olympic athletes (Berry *et al.* 1949). It would therefore appear that the distinction between a low but normal hæmoglobin and an abnormal one is not clear cut.

A number of factors are thought to influence the hæmoglobin content of healthy individuals. We were able to eliminate the effect of any diurnal variation (Renbourn, 1947) by collecting the bloods at the same time of day, but were unable to standardise the other environmental conditions which may alter the hæmoglobin level, *e.g.* temperature, climate, exercise and psychological reactions.

## CONCLUSION

The mean hæmoglobin value of 229 recruits and soldiers was found to be 15.4 g. per cent.

Two recruits out of 140 had hæmoglobin values under 12 g. per cent.

## ACKNOWLEDGMENTS

We should like to thank the officers commanding the units visited for their co-operation. We are also much indebted to the unit medical officers for providing the necessary facilities.

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## **GUNSHOT WOUND OF THE BLADDER**

### **AN UNUSUAL CASE**

BY

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THE following case history is of interest because of the length of time elapsing between wounding and the occurrence of symptoms.

On 16th July, 1944, in Normandy, whilst the patient was leaning with two friends against a wireless truck, it was hit by a German 88 mm. shell. One man was killed outright, the other died shortly after. The patient (W. M.) suffered multiple injuries, consisting of traumatic amputation of his left arm, extensive burns of the face and right arm, and penetrating wounds of the abdomen and left thigh.

Shortly after, at No. 24 Casualty Clearing Station, his wounds were dressed and laparotomy performed. Eight perforations of the ileum were sutured. There is no record of any injury to his bladder. Following evacuation to England he made a good recovery.

He was first seen by Mr. Thomas Moore at the Manchester Royal Infirmary on 10th November, 1955, when he stated that he had been quite well following discharge from the army, but during the previous five years he had had some discomfort in his perineum with intermittent dysuria, scalding and increased frequency of micturition. On no occasion had retention of urine occurred, but the stream was frequently poor, and on two occasions during the previous fortnight he had passed small clots of blood.

On examination his general condition was good, with a well-healed lower abdominal midline scar and a 3 in. oval scar over his left anterior superior iliac spine. Palpation over the bulb of the urethra produced excruciating pain. Two days later, whilst at home, he passed an irregularly shaped stone, which had to be extracted from his external urethral meatus.

Straight radiograph and intravenous pyelogram showed multiple small metallic foreign bodies in the abdominal wall and thighs and a 2 in. long shadow in close relationship to the bladder. This was oval, and projecting from one end of it was a narrower irregular opacity.

At operation on 10th December, 1955, the bladder was opened through a low transverse supra-pubic incision. The urine was clear and on examination the foreign body (see Plate facing this page) was found lying freely in the lumen of the bladder. It was extracted. The bladder mucosa showed no abnormality and there was no sign of infection or scarring, old or recent.

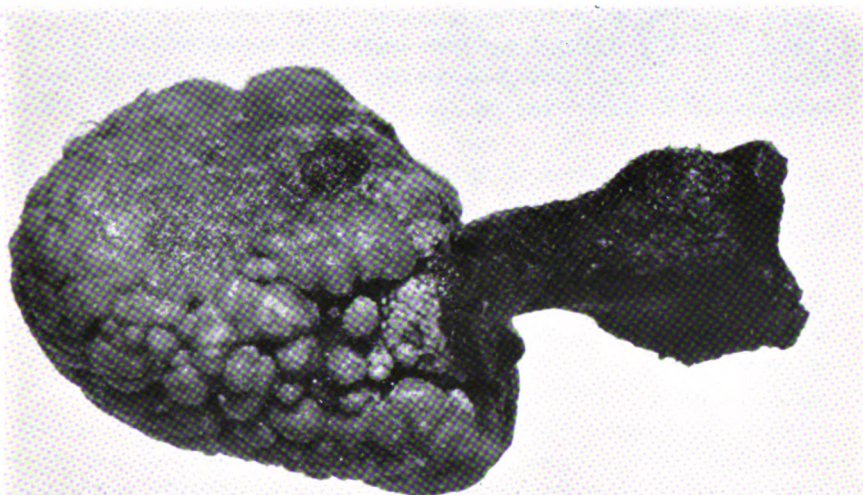
The bladder was closed following the insertion via the urethra of a Thomas Moore catheter, and continuous irrigation with 5 per cent citrate solution was started. The catheter was removed on the third day after operation as the urine was clear and sterile. His progress was uneventful and he was discharged on the tenth day after operation. When seen two months later he was quite well.

The specimen is 2 in. by 1 in. and consists of a piece of shrapnel, coated with calculus at one end only, his symptoms before admission being due to the passing of fragments of this calculus.

The interesting points in this case are : the length of history ; the absence of gross urinary infection ; and the absence of abnormality of the bladder wall. The radiographic appearances suggested that part of the foreign body was embedded in the bladder wall, the free end only being coated by calculus, but this was not the case.

At what time the shrapnel fragment passed through the bladder wall is problematical as neither at operation in 1944 nor again in 1955 was evidence of damage to the bladder wall noted.

I would like to thank Mr. Thomas Moore for permission to publish this case and Colonel G. W. Ollerenshaw, T.D., of the Department of Medical Illustration, Manchester Royal Infirmary, for the photograph.



Foreign body removed from bladder following gunshot wound





## SOME ASPECTS, MAINLY MEDICAL, OF THE GURKHA RECRUITING SEASON, 1955

BY

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*Royal Army Medical Corps*

THE British Government still has the right to recruit Gurkhas from Nepal for service in Gurkha battalions in certain overseas stations. At the present time, eight Gurkha battalions are in existence, and they are grouped into an organisation known as the Brigade of Gurkhas. In some ways this formation is very similar to the Brigade of Guards.

Recruiting, to make good the normal wastage in these battalions, takes place once per year, usually in the month of November. The number to be recruited each year varies and depends on the number leaving the service, and for the year in question some 1,000 recruits were required. This demanded a considerable effort over a short period of time, to medically examine these recruits. The existing medical potential on the Gurkha L. of C. was, naturally, somewhat thin on the ground, and D.M.S., G.H.Q., Far East Land Forces, was requested by H.Q., British Gurkha Troops, India, to send temporary reinforcements to help out, the minimum requirement being two doctors. At the time medical officers were in short supply, but it is wonderful what astute administrative officers can contrive. At any rate, when asked if I could possibly leave my unit for approximately two and a half weeks in order to proceed by air to Nepal on temporary duty, I was determined that all obstacles could and should be overcome. "The Green Eye of the Little Yellow God" had already begun to exercise its spell.

Wednesday, 26th October, saw myself and another R.A.M.C. officer reporting at 0600 hours to the B.O.A.C. office in the new Singapore international airport of Paya Lebar, ready to take-off at 0700 hours. But it was not to be. A Burmese transit visa had been omitted from our passports, and B.O.A.C. could not accept us. Sadly we returned home and a hectic day followed. There were interviews with "Movements," new plans made, new tickets obtained, all plans scrapped, a hasty dash to the Thai Embassy to obtain Thai visas and finally a new set of tickets issued.

Thursday, 27th October, saw us in the air by 0800 hours *en route* to Calcutta via Cathay Pacific Airlines. Midday saw us in Bangkok, where we were to stay overnight. The Airline provided us with extremely comfortable air-conditioned bedrooms in the Metropole Hotel, and all that prevented us from painting the town red was a lack of *ticuls*, the local currency. However, the hotel was able and willing to cash a traveller's cheque so even that difficulty was overcome, in a modest way. At night the Oasis Club provided a mixture of jazz music as played by a Philipino band and an exhibition of classical Siamese dancing. But it must be admitted that the cost of living in Bangkok is high. British cars

still predominate on the streets, but in the shops American goods are well to the fore.

Friday, at 1330 hours, saw us once again in the air bound for Calcutta, our remaining *ticuls* having been expended during the morning shopping. We arrived at Calcutta about 2000 hours and were met by a representative of "Q" (Movements), who very expeditiously saw us through Customs and Immigration. Then followed a fifteen-mile car journey to the H.Q., Gurkha L. of C., at Barrackpore to the north of Calcutta.

Next day my co-traveller had an early-morning start to catch a plane *en route* to Jalapahar, north of Darjeeling. He was to help out with recruiting in the eastern zone of Nepal. I lingered on at Barrackpore until the evening of Sunday, 30th October, enjoying the hospitality provided for the visiting Major-General, Brigade of Gurkhas. On Sunday evening I left Calcutta in an air-conditioned sleeper on my way to Lehra. On Monday afternoon I changed stations and trains at Lucknow and was lucky enough to obtain another air-conditioned compartment as far as Gorakhpur.

After a three-hour wait I caught a local train to Lehra. It left shortly after midnight, with myself in the one and only first-class compartment. The standard of comfort was perhaps not so high as previously, but it was a friendly train. It must have been, for it stopped very frequently at odd places while the driver and others in the train held long conversations with people at the side of the track. But there was now a definite nip in the air and that, coupled with my ignorance of the language, made me slightly impatient, until we arrived at Lehra Halt.

Gurkha Depot, Lehra, was finally reached about 0300 hours on Tuesday, 1st November; but my stay there was short. By 0900 hours I was on my way by Land-Rover to Paklihawa camp, the western zone recruiting base just inside Nepalese territory. The journey was rough, the roads practically non-existent, but each mile brought me nearer to the Himalayan foothills, with the majestic snow-capped peaks of Anapurna and Daulaghiri in the background.

My first sight of Paklihawa recruiting camp was, to say the least, arresting. It was a trim tented camp, set in an open grassy meadow or promontory, with the river on three sides. The area was dotted with shady trees. In the centre of the camp was a square "show-ring," and parading around it, dressed only in *dhotis*, was a long line of Gurkha recruits. In the middle were the "judges," the Chief Recruiting Officer (C.R.O.), the Deputy Recruiting Officer (D.R.O.), and Queen's Gurkha Officers (Q.G.Os.). As I watched, the parade broke into a trot and then a gallop. The similarity to a horse-show was unmistakable.

The C.R.O. haled me off the Land-Rover, welcomed me briefly, and, pausing only while I grabbed stethoscope and tendon-hammer, I was conducted forthwith to the tented Medical Centre. A short chat with the S.M.O., Major Ian Scott, and then he and I were hard at it. From then on, until recruiting finished on Friday, 11th November, we ate, slept and talked recruits. For nine to ten hours per day, ten minutes per man, six men per hour, the work went on. At the end of the day came the signing up of the documents; for each man examined, three signatures were necessary, on the F. Med. 1, F. Med. 4 and the attestation form.

On our best (or worst) day we examined 112 recruits between us, a total of 336 signatures being necessary at the end of the day.

A word or two on the background of Gurkha recruiting at this stage is probably necessary. The agreement with India stipulates that the recruitment, medical examination and attestation of Gurkha recruits will take place on Nepalese soil. Hence the need for recruiting camps at Paklihawa and Jalapahar. Once recruited, they are dispatched down the L. of C. pipeline to the Depot at Barrackpore and thence by ship to Malaya. No recruit training is allowed in India ; all basic training is done in Malaya at the Gurkha Training Depot, Sungei Patani.

But the recruits have still to be brought to the recruiting camps. How is this done? Gurkha recruiters, called *gallawallahs*, and usually old soldiers on pension, are engaged to cover the areas concerned. Before the recruiting season begins they are brought in to a central meeting-place, thoroughly briefed as to the type and quality of recruits required, and instructed to bring in a certain number of recruits, boys and adults, to reach the recruiting camp on a certain date. The *gallawallahs* have a certain basic pay, but they are also paid by results—viz., Rs8 per recruit accepted or Rs10 for an exceptionally good recruit, and Rs3 per boy accepted or Rs5 for an exceptionally good boy recruit. So that the incentive is there for the recruiter to produce good results. Boy recruits are wanted at the age of 15 years (approximately) and soldier recruits at the age of 17 years (approximately). It is usually rather difficult to verify ages exactly.

Let us now follow a party of recruits through the recruiting mill, from start to finish. They arrive at the recruiting camp, a long file of about thirty recruits, headed by the *gallawallah*. They are tired and dusty, having been perhaps ten to fourteen days on the march, perhaps all the way on foot or part of the way by bus or train. After being allotted tented accommodation, they are shown where the cookhouse is, told the times of meals and then allowed to settle in and rest. Next day or the day after, this particular *galla* or party are called on to the parade ground. There they are weighed and chest and height measurements recorded, as well as name, age and other particulars. After that, clad only in a *dhoti*, the "show-ground" parade already mentioned takes place. Races between four and six recruits also take place, giving the D.R.O. time to study his material.

Next day the final selection is done. Six, eight, ten or more *gallas* are assembled on the parade ground, each individual in each party being inspected by the D.R.O. accompanied by Q.G.Os. He speaks to each man in Gurkhali, in an effort to assess intelligence. Not a very scientific method, as each man is scared stiff anyway that he will not be accepted. At this time more data are available—viz., height, weight, age and chest expansion. Any recruit not conforming to the minimum standards laid down is now eliminated, as well as those with the more obvious degrees of knock-knee, bow legs and other structural peculiarities. In this connection I have been told by experienced Gurkha officers that a slight degree of bowing is a good thing, such men being better weight-carriers than the straight-limbed variety. I think it is probably true, and having seen the Gurkha in his own country carrying enormous loads (up to 160 lb.)

along the mountain passes back to his village, I have nothing but admiration for his stamina and load-carrying capacity. During this parade ground inspection some 30 to 35 per cent of recruits are rejected, many for reasons which I could not appreciate. But recruits were plentiful and the selectors had long experience of Gurkha troops.

After being accepted by the D.R.O., the recruits then came within the medical orbit for the first time. They paraded behind the medical treatment tent, where they had their vision tested, and also produced a urine sample for testing. After this had been done they formed up behind the medical examination tent.

The medical examination carried out was of the usual routine type and needs no special description. Ten minutes per man was the average time spent, but it must be remembered that I spoke no Gurkhali and they spoke no English. In self-defence I soon mastered a few words—“*Uthnu*” meant “*get up*,” and a few more. However, the main medium was sign language, and if I wanted a man to touch his toes or bend his knees, I had to show him. By the end of the day I felt exhausted, mentally and physically.

Here are a few of my impressions of these recruits, for what they are worth. They were a very fit bunch—they had to be to march for ten to fourteen days through the Nepalese mountains to reach the Recruiting Centre. They had a good physique and were well developed and nourished. I could detect no signs of malnutrition, except perhaps a certain rough feeling in the quality of the skin of certain of them. The appearance and feel of the skin certainly made me think of *pelle agra* (rough skin), but there were no other signs or symptoms. If time had permitted, it might have been possible through an interpreter to find out something about their diet, and whether they were predominantly rice or maize eaters.

Their dental condition was remarkably good. I understand that they use the twigs from a certain tree to scrub their teeth. In a few of them the second molar tooth on both sides, usually on the lower jaw, was almost completely destroyed. Questioning elicited the information that these people were in the habit of taking a pocketful of whole maize kernels with them to work. They chewed the kernels during the day and they attributed the poor condition of their molar teeth to the effect of cracking hard maize kernels. In other recruits the molar teeth were found to be worn down and quite smooth on the upper chewing surface. It was thought that this was due to the admixture of grit particles with the food, due to the use of primitive stone mills for grinding maize.

In examining the eyes, the lids were everted in a search for cases of trachoma. In all, about a dozen such cases were found and their names noted for placing under treatment. I can only remember two cases who failed on account of poor vision. In one *galla* of recruits it was noted that in many of them the skin junction at the inner canthus of the eyes was tight and protruded over the medial aspect of the eyes. In one extreme case this caused inversion of the eyelids and chronic conjunctival irritation. This condition was not due to trachoma, but it was considered that it could be relieved by a fairly simple plastic operation.

Ears were examined very carefully, as it was found that perforated drums and chronic otitis media were the most common cause of rejection of

recruits. Some 1.5 to 2 per cent were probably rejected on those grounds. Wax in the ears was extremely common and tended to cause delays in the medical examination, while ears were being syringed or, in the more extreme cases, the wax removed manually under direct vision, using a head lamp. Rice grains, grass seeds and other curiosities were removed from various ears, to the wonderment and often patent disbelief of the owners.

Chest examination usually did not prove to be very illuminating. Since the whole camp was suffering from a type of common cold, rhonchi were often heard and were not considered a cause for rejection. Illness in a recruit, unless extreme, was never disclosed until after he had been accepted or rejected. It was common to find a recruit coming up for medical examination with a burning skin, and on taking his temperature it would be found to be 102°-103° F.

Cardiac examination did produce about four cases of heart disease, either congenital or acquired. Most of them were well compensated—after all, they had to march for ten to fourteen days to reach the camp—but with recruits plentiful it was not considered justifiable to enlist them.

Abdominal examination was almost uniformly negative. A few cases of palpable spleen were encountered, but this was not considered to be a cause for rejection, since malaria was the most likely cause. Palpable spleens, due to malaria, are more commonly found amongst recruits from the eastern regions of Nepal. It was also found that certain recruits from the eastern border of the western recruiting area had an abnormally wide sternal angle. If examined carefully, the liver could be palpated in practically every case. Once again this was not considered to be a cause for rejection.

Although I have no exact figures for medical rejects, my general impression, based on recruiting in the western zone only, is that it was about 2 to 2.5 per cent, made up largely of ear conditions with cardiac abnormalities, poor vision and postural deformities such as knock-knee, etc., making up the remainder. Once the recruits reached the Depot at Lehra, they were sent in batches to Gorakhpur for M.M.R. examination. I did not hear the full result of this, but from past experience abnormal chest radiographs usually accounted for a further 1 to 5.5 per cent of rejects. I was told of one case from this year's recruits in whom the M.M.R. examination had shown the presence of a hydatid cyst.

From Tuesday, 1st November to Friday, 11th November, in all ten working days, approximately 640 recruits were accepted for military service. The main fighting clans were well represented, and surnames such as Gurung, Rai, Thapa, Pun and Limbu were as common as MacDonald, MacKenzie or Maclean might be in certain parts of Scotland. In addition to recruits from the fighting clans, a small number of the traditional tradesmen were also enlisted to meet the requirements of the battalions, and surnames such as Sarki (bootmaker), Kami (blacksmith) or Damai (tailor) were occasionally met.

After the recruits have been finally accepted by all concerned and enlistment documentation is complete, there comes the rather colourful ceremony of "taking the oath" and "touching the flag." The recruits, by this time rigged out in a uniform of sorts—and very proud they are of it too—form up in a huge horse-

shoe-shaped formation. At the open end of the horse-shoe is a table with the Union Jack spread on it and the officer in charge of the parade standing behind. A Q.G.O. goes forward in front of the table and slowly reads the oath of allegiance, while the recruits, perhaps some seventy strong, chant the phrases in unison as he reads. Somehow it seems to be so much more significant, taking the oath in this magnificent setting on Nepalese soil with the majestic, snow-capped peak of Anapurna in the background to bear witness to their testimony.\* After the oath the recruits come forward, six at a time, range themselves in front of the table, salute, touch the flag, salute, do a smart left turn and march off. Some of their salutes, although they have as yet had no training, would do credit to a guardsman. For indeed the military tradition runs strong in most of their families.

A few words might be said regarding the allocation of recruits to their respective battalions or units. In general, recruits from Western Nepal go to the 2nd and 6th Battalions respectively, while recruits from Eastern Nepal go to the 7th and 10th Battalions. Recruits with a family allegiance, either a father or a brother in one of the battalions, can state his preference for this battalion and is usually allocated to it. Recruits with no family ties or preferences are allocated as required, either to one of the battalions or to the Royal Engineers or Royal Signals.

No mention has yet been made of the lighter side of camp life. The camp was very comfortable, with one E.P.I.P. tent per officer as sleeping quarters, furnished with bed, table, bedside locker, chest-of-drawers and the usual camp washing facilities. A large marquee served as a mess, with lounge chairs and small tables at one end and the dining-table at the other. Gurkha mess servants provided admirable attention, although language difficulties made it a bit difficult from my point of view. However, I soon managed to say *ghusl pani* to indicate that I wished my bath to be prepared. "Whisky-soda" seems to be universally understood.

To begin with the meal situation struck me as being rather peculiar. Reveille was at 0630, but when I had dressed and presented myself at the mess tent in search of breakfast the mess waiter looked at me rather queerly. It was finally broken to me gently that breakfast was at 0930 hours, after two and a half hours' work on an empty stomach. But it was worth waiting for when it did come, as it usually consisted of about four courses. Lunch was at 1400 hours and dinner any time up to 2200 hours. Food was purchased mainly through a local contractor, and mutton in various forms was the usual main course. A loaf of bread occasionally arrived up from Lehra, but *chapatties* were usually served in lieu. The diet was certainly adequate.

At night the camp throbbed to the beat of the local type of drum, called a *madal*, and this was accompanied by singing and dancing. During the evening we

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\* *Oath to be taken by recruits on enlistment.* We swear by Almighty God that we will be faithful and bear true allegiance to Her Majesty, Queen Elizabeth II, her heirs and successors, and that we will, as in duty bound, honestly and faithfully serve in Her Majesty's Forces and go wherever we may be ordered, by air, land, or sea, and that we will observe and obey all commands by any officer set over us, even to the peril of our lives.

usually went down to the recruits' tent lines and looked in on some of the song and dance parties. This is usually called a *jhamre*. One, two or three people might be dancing to the accompaniment of drums and voices. The steps of the dance were set and traditional, but the vocal chant varied. One song which I rather liked described a spider spinning its web, and there were two other attractive numbers of which I was not able to get the translations. One of these I called "Saturday Night" and the other "L'amour." Phonetically and musically, my translation should not be far out.

While I was at Paklihawa, the camp was visited by General Anderson, Major-General, Brigade of Gurkhas, and Brigadier Graham, O.C. British Gurkha Troops, India. Lieut.-Colonel Murray, Gurkha Liaison Officer, War Office, was also in the party. Such a visitation, of course, demanded a *nautch*, and this was duly arranged and presented. It was my first experience of a Gurkha *nautch* and Gurkha rum. I am glad to say I enjoyed them both. The dancing and singing were, in my opinion, very akin to the Gaelic dancing and singing in my own country. I felt quite at home and indeed the Campbeltown Gaelic choir would not have been out of place at this assembly. The resemblance was heightened when three Gurkha pipe-majors gave a selection on the bagpipes, followed by a very expert sword dance performed by four Gurkha boys in full regalia. The *nautch* is an all-male performance, but certain dancers dress in female garb and dance the part of the women. In their female dress with all its finery these *marunis* looked very fetching. In all, a very pleasant evening.

Sunday, 6th November, was declared a holiday and recruiting stopped for the day. I managed to tack myself on to a picnic party arranged for the visiting celebrities. We went by Land-Rover as far as Badole in the foothills and picnicked on the steep side of a gorge, perched high above a fast-flowing river which issued from the hills. While we ate our sandwiches and drank our beer, we heard a dull boom up the gorge and then saw a party of Nepalese spread out across the river and start throwing fish on to the banks. Evidently they believed in fishing the modern way. After lunch we went down to the river and joined them, and after some parley it was agreed that they would throw a bomb for us for the sum of Rs6. This was duly done, with very satisfactory results. But it would take a better pen than mine to express the delight of these people at seeing two very high-ranking British officers (who shall be nameless), accompanied by my humble self, all attired briefly in underpants, waist-deep in the water and grappling gamely with slippery fish in that fast-flowing water. Of course, they helped us, and some thirty edible fish (about three or four to the pound) were eventually secured.

The fish were of two types, a large-scaled variety which we thought might be young mahseer, and a beautifully shaped fish which I thought might be blue-trout. At the finish, photographs were taken, with the senior officer holding a bamboo pole over one shoulder and a string of fish dangling from the other hand. The mess certainly appreciated the addition of fresh fish to the menu.

I could write much in similar vein, but space and time forbids. I will only mention briefly the occasional visits to our mess of the Governor or *Bara Hakim*



of the local district in which our camp was situated. He is an old ex-Q.G.O. whom certain people may recognize under his initials of N. B. G.—a most vivacious old gentleman who in his time had visited London. Unfortunately he spoke only in Gurkhali, so I was unable to follow his discourse, apart from such words as Buckingham Palace, Piccadilly Circus and Windmill Theatre.

On Sunday, 13th November, I left Paklihawa by Land-Rover for Lehra. On Monday, the 14th, I went by road from Lehra to Gorakhpur, passing through the beautiful and well-kept Indian State Forests in that region. At Gorakhpur aerodrome, after a cup of tea with the officers of an Indian Engineer T.A. battalion who were “brewing-up” there while on a route march, I flew by Indian Airlines Dakota to Calcutta. On the 17th, after the plane had been delayed for twenty-four hours, I flew by B.O.A.C. (tourist and very crowded) from Calcutta to Singapore, arriving at Paya Lebar on 18th November, at 0600 hours. My Indian-Nepalese trip had ended. I thoroughly enjoyed it.

## STITCHING WITH A HYPODERMIC NEEDLE

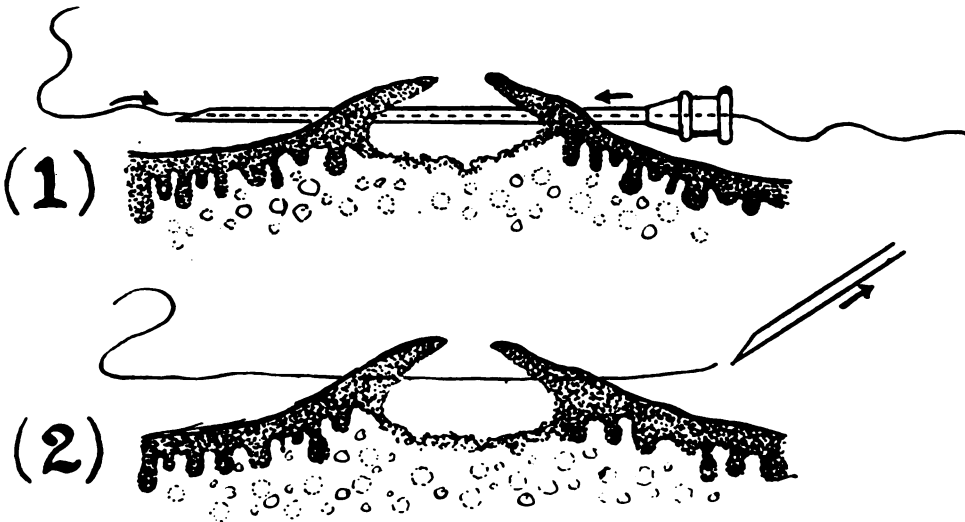
BY

**Captain M. J. GRYSPEERDT, M.B., B.S.**

*Royal Army Medical Corps*

SOME months ago I discovered, as I thought, an entirely new method of stitching, using a hypodermic needle. Subsequent conversations with elders of the profession have revealed that the method, if not as old as the hills, is at least as old as the sulphonamides. However, most doctors of my generation seem to be ignorant of it, and since the use of nylon as a suture material renders it easier to employ now than formerly, perhaps it should be publicised.

As the diagram shows, a hypodermic needle of appropriate bore is thrust through both lips of the wound, suture material is threaded through the pointed



end, and then the needle is withdrawn, leaving the suture ready for tying. The method is especially suited to rounded surfaces such as eyebrows and knees, or where the skin is loose. An assistant and several needles might save time in continuous suturing of operation incisions.

The advantages of stitching in this way seem to be :

1. It is very easy.
2. It minimizes trauma to the healthy skin edges by eliminating the necessity for pulling a bulky needle eye and two thicknesses of nylon through them.
3. Only a short length of needle has to be dragged through the wound, instead of a considerable length of suture material. In theory this should lessen the risk of infection and stitch abscess, and in practice I have had no such troubles using this method.

## AN UNUSUAL CASE OF RUPTURE OF THE UTERUS

BY

Lieut.-Colonel B. W. HUGHES, M.B., B.Ch., D.R.C.O.G.

*Royal Army Medical Corps*

THE patient first reported to the ante-natal clinic at the Military Families Hospital, Woolwich, when about eighteen weeks pregnant. She was 39 years of age, and had had three children normally—in 1937, 1940 and 1942 respectively. The biggest weighed 10 lb. In 1952 she had a lower segment Cæsarian section for “fœtal distress.” The baby weighed 8 lb. She had remained slightly and inexplicably pyrexial, despite antibiotics, until the thirteenth day following the operation, when she left hospital of her own accord.

During this pregnancy external version was performed twice (breech to vertex), and on the thirty-eighth week there was some hydramnios. Radiography revealed no fœtal abnormality.

The patient was about ten days past the expected date of confinement when she was admitted to hospital, a membrane sweep and rupture of the hind-waters were performed, 22 oz. of liquor being removed. The cervix was “ripe,” but the head was high at this time.

Labour started very slowly two days later with very weak irregular contractions. The head remained high and the draining liquor was meconium-stained. The fœtal heart remained normal. After thirty-six hours in labour, contractions were still weak, the head still high and the draining liquor now deeply stained with meconium. The fœtal heart remained normal. The patient began to look ill and had two rigors.

At this point it was decided that, if the head had not engaged and the contractions improved within four hours, Cæsarian section would be performed. However, in two hours the head suddenly “fixed,” in three she was full dilated and in four the baby was born. During the final hour the patient became shocked and immediately following the birth she was given two pints of blood. There was never any sudden pain at any time and her shock was not of sudden onset but increased gradually during the final two hours of labour.

After delivery the uterus contracted well and the loss was small. The child weighed 8 lb. 7½ oz. at birth and thrived. For the next few days the patient did not make progress. She remained pale and ill-looking with a pulse remaining around 100 and her blood pressure 140/90. The uterine involution was normal.

After five days the patient started to vomit increasingly large amounts, the abdomen was distended and tender, shifting dullness was elicited in the flanks and she complained of shoulder pain. The pulse remained at about 100 and of good volume. Enemata gave no release from absolute constipation.

Laparotomy was performed at this juncture. In the peritoneal cavity were

about 15 oz. of meconium-stained liquor. There was no blood. Along the line of the old Cæsarian scar at its right extremity was a tear which admitted the tip of the index finger.

The patient's condition did not justify hysterectomy. The liquor was removed and the patient sterilized. She made an uneventful recovery.

### SUMMARY

This is the report of a case of peritonitis caused by meconium-stained liquor amnii extruded through a rent in the scar of a lower segment Cæsarian section during the closing stages of a subsequent labour.

I would like to thank Mr. Keith Vartan for his wise counsel and help in this case.

---

### Correspondence

*From Major-General R. E. Barnsley, C.B., M.C., M.B.*

SIR,

Some time ago I acquired a painting of an "unknown purveyor," the date of whose service I was informed by Mr. Carman of the Imperial War Museum was probably between 1813 and 1816. In an endeavour to ascertain the identity of this young officer I sent a photograph of the portrait to *Country Life*.

I have received a letter from a reader in Essex which may be of interest to your readers. He tells me that he has in temporary custody some papers belonging to Deputy Purveyor G. Robinson, who was desperately anxious to obtain his Waterloo medal. The papers together with the medal itself are contained in a red morocco case, and among them is: "List of Medical Staff Officers under command of the Duke of Wellington who were employed in the field at the battles of Quatrebras and Waterloo."

The document is officially certified correct by Sir James Robert Grant, who was the Duke's S.M.O. at Waterloo and later became Inspector-General, and I feel it is of sufficient importance to merit a permanent record in the JOURNAL.

I have substantial hopes that this unique exhibit may find its way into our Historical Museum.

I am, etc.

R. E. BARNSELEY.

R.A.M.C. HISTORICAL MUSEUM,  
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HANTS.

List of Medical Staff Officers under command of the Duke of Wellington who were employed in the field at the battles of Quatrebras and Waterloo.

<i>No. of Certificate</i>	<i>Division or Corps</i>	<i>Rank and Name</i>
1	1st Corps	Deputy Inspector of Hospitals, J. Gunning.
2	2nd Corps	Staff Surgeon H. G. Emery.
3	Cavalry	Deputy Inspector of Hospitals, W. Taylor. Staff Surgeon, R. Grant. Staff Surgeon J. G. Van Millingen.
4	1st Division	Acting Deputy Inspector of Hospitals, W. Curtis.
5	2nd Division	Staff Surgeon, John Maling.
6	3rd Division	Physician to the Forces, Dr. Damecke. Assistant Staff Surgeon, J. Dease.
7	4th Division	Staff Surgeon, J. Matthews. Hospital Assistant, W. Canning.
8	5th Division	Staff Surgeon, M. A. Burmester. Hospital Assistant, Watson.
9	(erasure)	Deputy Assistant of Hospitals, Dr. J. R. Hume. Assistant Staff Surgeon, W. Twining.
10	Field Equipment	Inspector General of Hospitals, Dr. Grant. Deputy Inspector of Hospitals, W. Wool- rich. Apothecary to the Forces, W. Lyons. *Deputy Purveyor of Hospitals, G. Robinson. Hospital Assistant, J. Lough. Hospital Assistant, W. Williams.

---

\* This is the officer referred to by General Barnsley in his letter.

## *Book Reviews*

THE TREATMENT OF FRACTURES (Translated from the 13th German Edition), in two volumes. Lorenz Bohler, M.D. New York : Grune & Stratton. Vol. I 1956 and Vol. II 1957. Pp. 1508+xxxix. Illustrated. \$17.50.

In revising this classic work, Bohler has included the results of his experiences in the Spanish Civil War and in World War II as well as his work in Vienna. In twenty years his methods have changed only very little ; the basic principles that he enumerated and the essential plaster technique remain firmly entrenched.

Volume I deals with fractures and wounds in general and with injuries of the trunk and upper limb in particular. It is a large volume of over 1000 pages, extremely well illustrated and containing many interesting case notes. Treatment is discussed fully and technique described in detail. Faults in technique and bad methods are pointed out in the text and by illustrations. His style of repeating important points is monotonous, but it serves its purpose in impressing them on the memory. No one who has read the book would for instance ever forget the danger of excessive traction.

Not all will agree with everything he advocates, such as insistence on the reduction of vertebral fractures and his decided bias towards the non-operative treatment of closed fractures, but his opinions are based on a vast experience of his own cases and of the mistakes of others. His opposition to operative treatment is directed not so much against the skilled specialist in osteosynthesis as against the inexperienced operator, and with this attitude few can disagree. If the inexperienced surgeon would read this book and carefully follow the instructions in it he could not go far wrong in the treatment of fractures.

Volume II deals with injuries of the hip joint and of the femur. In its high standard and in its style of production it is similar to Volume I. The book is out of date in advocating "baking" in the treatment of shock and in the use of the Judet acrylic prosthesis to replace the head of the femur. The Thomas splint is regarded almost as a curiosity used by the English, while the "Tobruk" is not mentioned at all. Apart from these obvious incongruities, the volume contains an excellent account of the injuries of the hip and femur and details of sound treatment of them. There is a good description of the techniques of the use of Smith-Peterson nails, nail-plates and intramedullary Kuntschner nails. These are some of the exceptions to the author's general adherence to non-operative methods of treatment.

P. R. W.

THE MICROSCOPIC DIAGNOSIS OF HUMAN MALARIA. PART II. A MORPHOLOGICAL STUDY OF THE ERYTHROCYTIC PARASITES. John W. Field, C.M.G., M.D., Director, Institute for Medical Research, Federation of Malaya, and P. G. Shute, Assistant Director, Malaria Reference Laboratory, M.R.C. Kuala Lumpur : B. T. Fudge. 1956. Pp. 251+x. Illustrated. Not priced.

This study is strongly recommended to all pathologists with tropical experience. It will, undoubtedly, be a salutary experience to many to realize how

little they actually know of the forms and variations of the human malaria parasites.

As well as a chapter on the history of the microscopic diagnosis of malaria, full of interest, with extracts from the writings of famous malariologists of the past, there are chapters on methods of examination and technical miscellanea which should be of considerable value. Particular attention should be paid to the methods of preservation of material for teaching purposes.

The bulk of the book consists of descriptions of the various forms of the malaria parasite, illustrated effectively by non-coloured and coloured plates. The pitfalls of foreign-bodies and artefacts masquerading as malarial parasites are also well exemplified.

Although this book will be of particular value to malariologists and pathologists, the clinician will find in it much of interest and assistance in the diagnosis and treatment of malaria.

D. W. B.

AN ATLAS OF DISEASES OF THE EYE. E. S. Perkins, M.B., F.R.C.S. and Peter Hansell, M.R.C.S., F.R.P.S. (with Foreword by Sir Stewart Duke-Elder)  
London: J. & A. Churchill Ltd. 1956. Illustrated. Pp. 91+ix. 42s.

This is an excellent book of illustrations of diseases of the eye, both internal and external, and should be of great value to the student, general practitioner, and general specialist alike. The pictures are of a high order of excellence, both artistically and as representing the conditions described, and short concise descriptions of each appear on the opposite page. A short foreword by Sir Stewart Duke-Elder defines the scope and purpose of a very useful book. The generosity of Roche Products Ltd. has made possible publication at a very moderate price.

J. B. G.

TEXTBOOK OF HUMAN ANATOMY. Various authors. Edited by Professor W. J. Hamilton, D.Sc., M.D., F.R.S. London: Macmillan & Co. Ltd. 1956. Illustrated. Pp. 1022. £5.

To those interested in the teaching of anatomy, this textbook, with six distinguished anatomists as authors and something quite new in the way of layout, offers a challenge. It may be true that it is not easy to teach an old dog new tricks, and the well-known standard textbooks will die hard if at all. However, topographical anatomy changes little, but this is not a reason why the approach to its study may not alter. In fact this change of approach is long overdue. Therefore, it is refreshing to recognize that an effort is now made by this book to bring teaching and learning of anatomy into line with modern requirements. It may not be too long now before further progress is made and some teaching of "physical signs" is included in the preclinical study of anatomy to the benefit of all concerned. Anatomy is a very living thing and the approach to it should be likewise.

A. G. D. W.



## ***Matters of Interest***

GEORGE KNIGHT CLOWES MEMORIAL PRIZE ESSAY COMPETITION, 1958

Prizes : First prize, £35 ; Second prize, £15.

Closing date : 8th January, 1958.

**Subject :** In Naval warfare the demise of the battleship was brought about by the development in the superiority of armaments over armour. The horse was driven from the battlefield because of its vulnerability to the fire of modern weapons, and by barbed wire and other obstacles.

Some people think that, owing to more powerful anti-tank guns and mines, and the increasing efficiency of air action against ground targets, the tank is likely to go the same way as the battleship and the horse.

Discuss this.

General conditions for this essay competition will be the same as for 1956 and are contained in A.C.I. 405/1956.

GOLD MEDAL AND TRENCH GASCOIGNE PRIZE ESSAY COMPETITION, 1957

Prize : Thirty guineas and Gold Medal.

Closing date : 15th November, 1957.

**Subject :** It appears obvious that a sufficient number of volunteers will not be forthcoming to maintain our forces at an adequate level. Discuss some of the methods by which the Regular content of the Armed Services could be supplemented when the National Service Act expires in 1958, and say which you think will best meet the requirements of the Services and the Nation as a whole.

OR

The Communist Powers are conducting a determined drive for leadership of the under-developed peoples of the world by economic, cultural, and military influences and pressures. Discuss what they have achieved and give your views on the counter-measures which the Free World should now take.

General conditions for this essay competition are contained in A.C.I. 125/1957.

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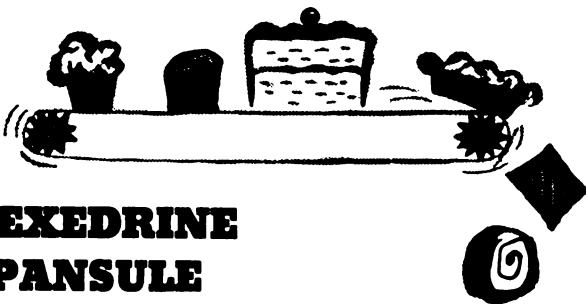


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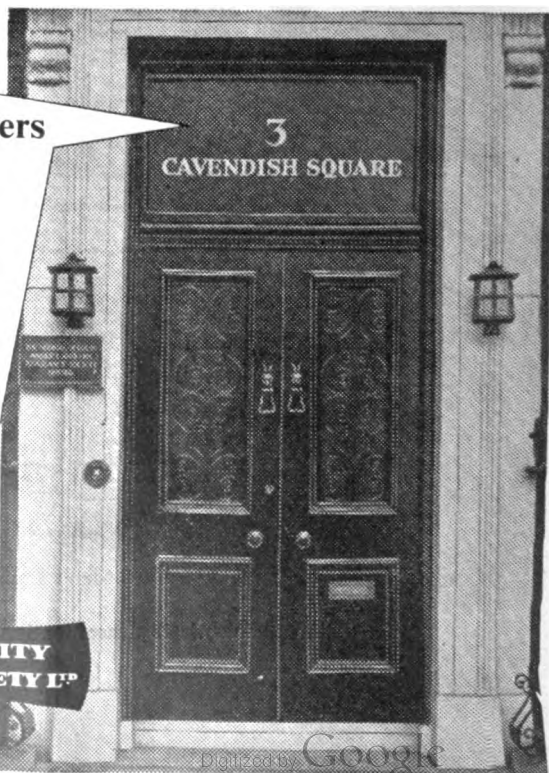
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**GEORGE MACDONALD, C.M.G.**

*Director of the Ross Institute and Professor of Tropical Hygiene London School of Hygiene and Tropical Medicine*

Although there are few places where malaria occurs for which the local epidemiology is not recorded in considerable detail, the accumulated data fail to explain some of the most obvious differences in parasite prevalence, transmission season, degree of endemicity, epidemic potential, and amenability to control in places where they might be expected to be similar. Gross differences unexplained by biological knowledge may be found throughout the world, and these differences lie in so many characteristics that the epidemiological picture must be described separately for each area, since they do not seem to be related by any matter of principle.

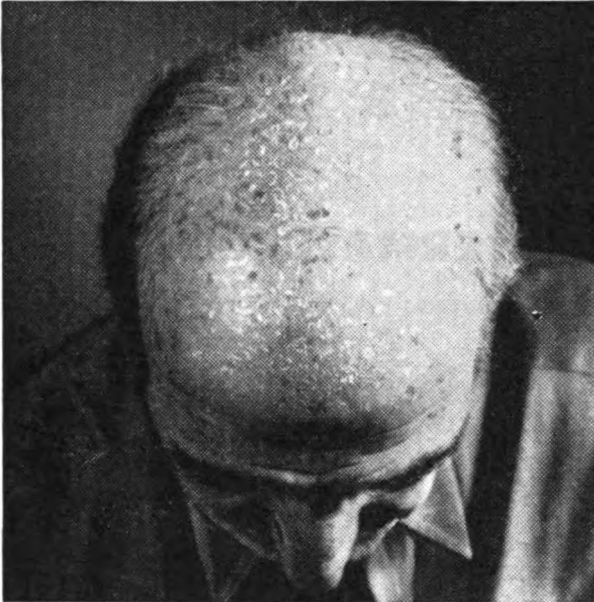
In the knowledge built up by a combination of circumstantial and biological study the explanation of the relationship between one event and another is lacking. This deficiency can only be supplied by mathematical study and it is the purpose of this work to describe afresh the epidemiology and control of malaria with the help of this additional method.

It has been written specially for the non-mathematical reader who wishes to be familiar with the implications and conclusions of this new approach to the subject, and it gives a new and much simplified world picture of the disease, in which the biological and circumstantial data have been integrated into one coherent whole.

The book shows how the various factors of the transmission cycle can now be related to each other and to the relevant biological characteristics of the mosquito; it describes how the changes to be expected in infection rates following changes in one of the transmission factors may be accurately forecast; and it explains why they differ so greatly in extent under different circumstances, and how the recorded data for one country may be related to that for another. The mathematical form of epidemiology does not attempt to replace either the circumstantial or biological branches of the subject since it is dependent upon both, but it makes possible a rational understanding of the disease.

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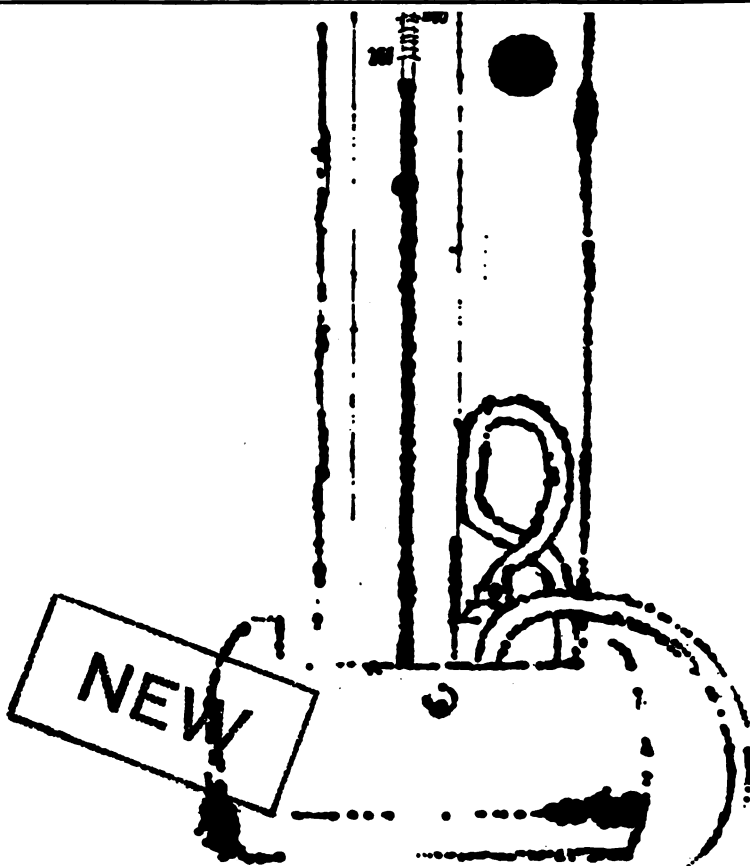
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Bird's-eye view of the Royal Army Medical College (Mess and Officers' Quarters Block) from the North-East.

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# Journal of the Royal Army Medical Corps

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## THE HISTORY OF THE ROYAL ARMY MEDICAL COLLEGE\*

BY

The late Colonel J. B. NEAL, T.D.  
*Royal Army Medical Corps*

THE Royal Army Medical College is the direct descendant of the Army Medical School, founded at Fort Pitt, Chatham, in 1860, on the recommendation of the Royal Sanitary Commission of 1858 (1), and moved to Netley in 1863 on the opening of the Royal Victoria Hospital.

Although, before this time, there had been no provision for the systematic instruction of medical men in the military aspects of their duties when they joined the army, it had been the practice for those who were not directly appointed to regiments to begin their service at the York Hospital, Chelsea, or at the General Invaliding Depot, at first in the Isle of Wight and later at Fort Pitt, where they learned, by association, something of military medicine, and where there were a museum of military medicine and a library, both established by Sir James McGrigor (Director-General of the Army Medical Department, 1815-1851).

Long before the deliberations of the Sanitary Commission in 1857-8 which led to the foundation of the Army Medical School, enlightened opinion had suggested that some instruction of army surgeons in their military duties was called for, the first indication of this view being expressed in a letter by John

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\* The Royal Army Medical College was opened in its new premises at Millbank on 15th May, 1907. The plate is taken from the second volume of the Journal published in 1904.



Bell, surgeon at Yarmouth, addressed to the First Lord of the Admiralty in 1798. This letter may be found quoted and discussed in Sir George Ballingall's *Military Surgery* (2) and in a paper by Colonel Kenneth Macleod (3). The outcome, however, was the establishment, not of a joint School for the instruction of naval and military surgeons, but of two Regius Chairs of Military Surgery, one in Edinburgh in 1806 and one in Dublin in 1851, to which Dr. John Thomson and Dr. Thomas Jolliffe Tufnell were respectively appointed. Tufnell, who had begun lectures in Military Surgery in 1846, was the first and only incumbent of the Dublin chair, and as an aid to his instruction he formed a museum of specimens of military medical interest which was later acquired by the War Department and incorporated with the existing museum in the cellars of Fort Pitt. Thomson should be remembered for his report on the British Military Hospitals in Belgium after the Battle of Waterloo (4); his successor, Sir George Ballingall, was a prolific writer upon military medicine.

Following the recommendations of the Sanitary Commission, a further committee was appointed to organise the new Medical School to be established at Fort Pitt. Immediate opening at Chatham was thought preferable to waiting for the new invaliding hospital to be built at Netley, partly because it was desired to avoid delay, and partly because the Chatham Hospital served a large garrison which contributed cases of acute disease to the wards, in addition to the chronic sick received as invalids from overseas and the insane who were accommodated and treated, under conditions surprisingly humane for the time, in Fort Clarence (5, 6, 7).

It was early decided that the School should be governed by a Senate, composed of the Principal Medical Officer at Chatham, the Professors, the Director-General of the Army Medical Department, and the President of the Medical Board at the India Office, reporting its proceedings through the Director-General to the Secretary of State for War. Three Professors were appointed, Dr. E. A. Parkes (Hygiene), Surgeon-General W. C. Maclean (Military Medicine) and Surgeon-General Thomas Longmore (Military Surgery); to these were added, on the protestations of Miss Florence Nightingale, a professor of pathology, William Aitken.

The teething troubles of the School are illustrated by the following extract from Mrs. Woodham-Smith's biography of Miss Nightingale (8) :

"Sidney Herbert had just had a demonstration of War Office power in the matter of the Army Medical School. Miss Nightingale had set out the necessity for an Army Medical School in *Notes on Matters affecting the Health, Efficiency and Hospital Administration in the British Army* (9). 'Young men were sent to attend the sick and wounded who perhaps had never dressed a serious wound, who certainly had never been instructed in the most ordinary sanitary knowledge, although one of their most important functions was hereafter to be the prevention of diseases in climates and circumstances in which prevention is everything.'

"The School was designed to provide training in military hygiene and military surgery. Miss Nightingale drew up the regulations in conjunction with Sir James Clark, and the nomination of the professors was left entirely in her hands. The

third of the four sub-Commissions which Sidney Herbert extracted from Lord Panmure was concerned solely with it.

"The nominations were made in 1857. Dr. Parkes, the great military sanitarian, was to be Professor of Hygiene, and Dr. William Aitken, afterwards Sir William Aitken, to be in charge. Panmure could not be got to the point of making the appointments : he would not actually appoint anyone 'even if the Angel Gabriel had offered himself, St. Michael and all angels to fill the different chairs,' wrote Sidney Herbert. Panmure went out of office and General Peel succeeded him, but still nothing was done. Then General Peel was succeeded by Sidney Herbert, who wrote that something should be done about the Army Medical School 'at last.' He converted nominations into appointments, but still delay continued : the officials at the War Office were not yet defeated. Premises were selected at Fort Pitt, Chatham, yet work on them did not begin ; the professors were appointed, but their salaries were not paid ; requisitions were sent in for instruments and equipment, but they were not filled. Month added itself to month, it was a year, it was two years, it was nearly three years before the original authority for the establishment of the School had been given, and still nothing had been accomplished. In 1860, Sidney Herbert insisted on fixing a day for the opening of the School. Three letters sent by Miss Nightingale to Douglas Galton, in August of that year, relate what occurred. The first, from Dr. Aitken, marked 'Wail No. 1,' states : 'No work even begun.' The second, also from Dr. Aitken, marked 'Wail No. 2,' states : 'No money for instruments.' The third, from Miss Nightingale herself, dated September 3rd 1860, marked 'Wail No. 3,' relates 'the disaster of the opening day.' 'On Saturday I had a letter from the Professors of the Medical School quite desperate . . . the authority for the money and the instruments had not yet come. Ten of the students arrived. They stared at the bare walls, and in the absence of all arrangements for their work concluded that the School was a hoax.' "

Despite these discouragements, however, the first course duly began on 2nd October, 1860, an introductory address explaining the objects and methods of the School being given by Surgeon-General Longmore (10). Each course lasted for five months, and after the first five courses, the School was transferred, under the supervision of a committee composed of Sir James Clark, Sir James Ranald Martin and Dr. John Sutherland, to the newly completed hospital at Netley.

Here a large ward had been converted into a class-room, another into an operating theatre: accommodation was found in the central block for professors' and secretarial rooms, a library and a museum. Some of the buildings behind the hospital were appropriated as hygiene and pathology laboratories, and quarters and mess buildings assigned to the young officers. The sixth session, the first at Netley, was opened on 1st April, 1863.

At this time the Medical Candidates, as the probationary surgeons were styled, were limited to those seeking appointment to the Medical Department of the British Army, but in 1865, with the reopening of recruiting for the Indian Medical Services, men who had passed the entrance examination for them attended the Netley courses on equal terms with their British Service colleagues. From 1871 until 1880, probationers for the Royal Naval Medical Service

attended the courses also, an additional professor being appointed to teach Naval Hygiene. During this period the Medical Director-General of the Royal Navy was a member of the Senate.

Candidates for Commissions in the British and Indian Medical Service entered the School by competitive examination, the marks obtained being added to those awarded in the examination held at the end of the course to determine the candidates' order of merit, and hence their seniority in the army. The minutes of the meetings of the Senate, the examination papers and the candidates' marks are still retained in the library of the Royal Army Medical College (11). At the beginning of every session a formal introductory lecture was given by the professor whose normal teaching day it was, while at the end of each course prizes were presented and a valedictory address given by some person of distinction in the army or the medical profession.

The minutes are far from being dry bones. For example, Mr. James Borchart, who had been Secretary of the School since 1868, protested in 1893, at the age of 75, at the proposal to dispense with his services, on the grounds that he had been given to understand, when joining the School, that his was a permanent appointment.

From time to time moves were made in Parliament to close the School on grounds of economy, the contention usually being that as the medical candidates were already qualified to practise medicine throughout Her Majesty's dominions, public money was being wasted on the maintenance of a school which could only teach either what they already knew or what they would speedily learn in practice. In fact, then as now, tropical medicine was taught hardly, if at all, to the medical undergraduate; emergency surgery was the smallest part of the student's experience, and he came into the service knowing nothing of the peculiar stresses imposed upon a wounded man by transport, climatic conditions and the privations inseparable from active service; hygiene was little taught and less examined; and although from its inception the Army Medical School has been equipped with microscopes (indeed, the official name for the pathology laboratory at Fort Pitt was "The Microscopical Room"), when David Bruce began in 1890 to give the first systematic course in bacteriology in England, qualified medical practitioners were entering the School and service without having ever looked down a microscope. Furthermore, the examination of recruits before enlistment and of invalids before discharge had to be conducted with a precise knowledge of the requirements of the service if public money was not to be wasted upon men unlikely ever to make efficient soldiers. Any criticisms levelled at the Army Medical School on grounds of redundancy were therefore readily rebutted, since it was abundantly clear that all these subjects, and others, were well taught by professors, and their assistants, of wide experience and the highest academic standing.

The School therefore continued until the time of the South African War, when the adverse comments levelled at the newly formed Royal Army Medical Corps were examined by a Royal Commission (12). Among the recommendations made by this body was one that "a military Hospital and Medical Staff

College for training of officers would add materially to efficiency, and immediate steps be taken by the Advisory Board to prepare a scheme for the establishment of one." The advantages of having a military medical instructional establishment in London, in close proximity to the great teaching hospitals, was apparent, and preparation of plans was at once begun. The last full course to be held at Netley closed on 29th June, 1902, when the prizes were distributed and an address given by Field-Marshal Earl Roberts of Kandahar, V.C.

Premises were hired in London, and on 1st September, 1902, classes in hygiene, pathology and hospital administration were begun in the Examination Hall of the English Conjoint Board on the Victoria Embankment. Entrants to the R.A.M.C. and I.M.S. attended this course during September and October, Lieutenants on Probation, R.A.M.C. then going to Aldershot and those of the I.M.S. to Netley for instruction in military medicine and surgery. During this phase, while the Netley School remained partly in existence, the London Department was known by the Royal Commission name of the "Medical Staff College." Further transfers were gradually effected, until the final closing address was given at Netley on 31st May, 1905, by Surgeon-General A. M. Branfoot, I.M.S., President of the Medical Board at the India Office. Classes continued to be held in temporary quarters until the present College was opened on 15th May, 1907 (13).

The Senate was abolished and control vested in a Commandant and Director of Studies, responsible to the D.G.A.M.S.

Bi-annual courses for Lieutenants on Probation and for Captains qualifying for promotion to Major continued until the outbreak of war in August 1914, when teaching ceased and the College became a centre for the production of vaccines, and, later, for investigation into methods of protection against chemical warfare. Research into insecticides, problems of nutrition, protective inoculations, and other matters affecting the health of the soldier was pursued. At the conclusion of the First World War, teaching activities were gradually resumed, and they continued until 1939, when war again terminated the normal routine of instruction.

Courses in tropical medicine were maintained throughout the Second World War, and were attended, up to the end of 1945, by some 3,000 officers. The Vaccine Department was moved to the country early in September, 1939, and air-raid damage compelled the transfer of the Hygiene Department to Mytchett from the end of 1940 until March, 1943. As in the 1914-18 war, the College again became primarily a research establishment, investigating problems of water supply, clothing and equipment, field rations and, possibly most important, the suppressive and toxic effects of mepacrine.

Senior officers' courses were resumed in February, 1946, and courses for officers on first appointment to the Corps in 1948. At the present time, courses are held twice a year for senior officers and officers on appointment to Short Service Commissions; instruction for National Service medical officers is practically continuous; special classes are held for officers of Queen Alexandra's Royal Army Nursing Corps and for other ranks, R.A.M.C. and Q.A.R.A.N.C.,

as well as for officers taking the D.P.H., D.I.H., and D.T.M. & H. and for those reading for higher qualifications in medicine and surgery.

The spacious laboratories and well-equipped lecture theatre are frequently in demand for meetings of scientific societies. Recent expansions of the work of the College include an entomological reference bureau, a serological reference laboratory and the Army Tumour Registry.

### THE MUSEUM\*

In 1810, Dr. James McGrigor, while Principal Medical Officer at Portsmouth, instituted a collection of morbid anatomical specimens at Hilsea, which was transferred in 1816 to the York Hospital, Chelsea, where many additions were made to it. The collection was later moved to Fort Pitt, Chatham, and augmented not only by morbid anatomical specimens but also by rare and curious specimens in botany, zoology, geology, anthropology and archeology, sent by military medical officers from all parts of the world. This museum formed the basis of the teaching collection when the Army Medical School opened in 1860, when it was augmented by the addition of Dr. Tufnell's collection of carriages, instruments and appliances, brought from Dublin. This last collection was deeply drawn upon by Surgeon-General Longmore in compiling the first edition of his *Treatise on Ambulances* (1869) (14).

Although no systematic instruction was afforded to newly joined medical officers before the establishment of the School, they were required to perform routine duties under supervision, including autopsies. Some of the report books still survive in the Library. Some of the material thus, and otherwise, accumulated was made available to a wider public than the medical officers serving in Chatham by the publication between 1824 and 1850 (15) of a series of elegant atlases of morbid anatomy, based upon specimens in the Fort Pitt collection.

No account of the early days of the museum could be complete which failed to mention Surgeon-Major George Williamson (1819-1865). As a young Assistant-Surgeon, he was curator of the museum at Fort Pitt, of the contents of which he compiled a catalogue which was printed in 1845 (16). Some of the specimens listed still remain in the College pathology museum, notably an excellent goundou skull from West Africa and some of Williamson's minutely painstaking dissections, coloured, varnished and mounted. But his principal claim to the fame which has eluded him, and the chief glory of the museum, was the collection of over 450 human skulls, of which Williamson published a catalogue in the *Dublin Quarterly Journal of Medical Science* in 1857 (17) (subsequently reprinted as a separate pamphlet (18)), which appears to have been the first British work upon the ethnological implications of craniometry. The

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\* Only the Pathology and Army Health Museums can be said to have survived from the original Netley Museums. The present Army Health Museum in the College, which is designed to illustrate the teaching of the Army Health Department, is directly descended from that built up by Dr. Parkes, the first Professor of Military Hygiene at the Army Medical School. Many vicissitudes, not least the Millbank flood in 1928, have, however, completely changed the character of the museum; models and specimens have largely given way to photographs and an accompanying text.—ED.

late Professor Arthur Thomson has written a sympathetic account of Williamson's work (19).

Ever since its inception, the museum has undergone depredation as well as augmentation. Subject to several removals, severely damaged by the Thames flood of 1928, virtually gutted by air attack in September, 1940, and depleted by the failure to return some of the specimens evacuated, for safety, during the 1939-45 war, little now remains of the earlier collections : in particular, Williamson's collection of crania has been lost to the College. It was transferred in 1931 to Oxford University and thence in 1946 to the British Museum (Natural History), where it now is. The present museum, being slowly re-instated both as to structure and contents, is almost wholly modern.

Some fifty years later, production of another catalogue of the whole museum was contemplated, but the only volume to be published was the first, of the pathological specimens, compiled by Sir William Aitken (20).

### THE LIBRARY

The Library, founded in 1816, was annexed to the museum in 1822. Medical officers of all ranks generously contributed to it, Sir James McGrigor, to whose initiative the inception of the Library was due, presenting on a single occasion 1,500 volumes. Sir James was an assiduous collector of books (21), as well as the frequent recipient of complimentary copies from authors, as such of his collection as remains in the Library bears witness. It will thus be appreciated that, although for some forty years past a Crown grant has been made for upkeep of the Library, the founding and maintenance for nearly one hundred years were entirely due to voluntary effort by medical officers of the army.

From time to time the collection has been enriched by considerable gifts and bequests, notably :

- (a) The Waring Gift, principally of clinical works of the nineteenth century, of great practical value to the Medical Candidates at Netley at the time the gift was made.
- (b) The Fayrer Collection, of the works of, and books collected by, Sir Joseph Fayrer. Sir Joseph, an eminent physician of the later nineteenth century, had served as a surgeon successively in the Royal Navy, the Ordnance Medical Department and the Bengal Medical Service, and for eighteen years represented the India Office upon the Senate of the Army Medical School. The collection includes the manuscript of Sir Joseph's autobiography (bound in nine volumes, in half morocco), some of his personal operation registers, and several volumes of his lectures and contributions to medical literature.
- (c) The Johnston Collection, consisting mainly of sets of orders, regulations and other ephemeral material bearing upon military history. Colonel William Johnston, compiler of the "Roll of Commissioned Medical Officers" (22), was the first Staff Officer for the Army Hospital Corps when control of the Corps was transferred to the Army Medical Department in 1882. He fought hard for the well-being of the medical

services of the army, and is one of the five men commemorated by the bronze plaque over the Library door, "from the officers of the R.A.M.C. to those who helped to found it."

- (d) The Spiller Collection, of books on Indian topography, the Sepoy Mutiny of 1857-59 and other Indian subjects.
- (e) The Sir William Macpherson Gift, of works on military medical administration, tactics and history. Lastly, in this connection, mention should be made of :
- (f) The Sir Everard Home Collection. This, the remains of the personal library of Sir Everard Home, Bt., F.R.S., contains a high proportion of theses and eighteenth and early nineteenth-century pamphlets. Sir Everard, surgeon to St. George's Hospital and Serjeant-Surgeon to King George IV, retired from the army to become Surgeon to the Royal Hospital, Chelsea (1821-1832). The mahogany press in which the collection is housed was specially designed for it by Sir John Soane, Home's contemporary as Clerk of Works (1807-1837) at Chelsea Hospital. This collection is held on permanent loan from the Commissioners of the Royal Hospital.

Much of the Army Medical School Library, as the older collection of books is known, remained at Netley until 1927, when it was brought to London, though some part had previously been transferred. The present Library, therefore, consists of two parts, the older collection, representing the A.M.S. Library augmented by books from station medical libraries overseas as these have been closed from time to time, and a modern library of text-books, monographs, pamphlets and journals, maintained partly by Crown grant and partly by gift, for the day-to-day working use of the staff and students of the College.

The Library, like the museum, has been depleted in the course of time, notably during the period of disuse at Netley from 1905 to 1927, and by fire and water during the air raid of September, 1940. Rye's Guide (23) notes the Library as containing some rare early items, but not all of these now remain.

#### THE MUNIMENT ROOM

In close proximity to the Library, though nominally a detached part of the R.A.M.C. Historical Museum established at Queen Elizabeth Barracks, Crookham, Hants, the Corps Depot, is the Muniment Room, a repository for books, documents and manuscripts bearing upon the history of British Military Medicine.

It contains, among other items, personal papers of Sir William Leishman, Sir David Bruce, T. R. Lewis, Major-General R. J. Blackham, Colonel C. H. Milburn (who was intimately associated with the negotiations which led to the issue of the R.A.M.C. Warrant in 1898), and Colonel H. A. L. Howell, an assiduous student of military medical history and editor of Johnston's Roll after Colonel Johnston's death.

Of great interest and importance is a collection of seventeen water-colour



drawings of war injuries of the battle of Waterloo, executed by Sir Charles Bell and illustrative of cases treated by him in Brussels in 1815. Many of the follow-up notes of these cases, by the military surgeons in whose charge the patients were left after Bell's return to England, survive, but Sir Charles's original sketch-book and his interleaved copy of his work on Gunshot Wounds (24) can no longer be found.

### CONCLUSION

The preface to an early printed catalogue of the Library (25) expressed the hope "that the time may come when the Medical Department of the Army shall have an Establishment of their own in the Metropolis, which will not only contain the museums of Anatomy, of Natural History, and their Library, but afford means for officers from all parts of the world again meeting and associating with others who have more recently entered the service, and thus afford the opportunity to exchange opinions or professional questions."

The recommendations of the South African Commission opened the way to the fulfilment of this hope, now fully realised in the College, Headquarter Officers' Mess and The Queen Alexandra Military Hospital, Millbank, together in close and constant touch with all that is best in the medical life and teaching of London, to the benefit of the sick soldier and the enhancement of the professional standing of the Royal Army Medical Corps.

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# CHEMOTHERAPY OF THE RETICULOSES

BY

**J. B. HARMAN, F.R.C.P., F.R.C.S.**

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UNTIL the Second World War, the only treatment for the reticuloses that was at all specific was radiotherapy. The position is now quite different. In the first place the use of ionising radiations has been extended by the radioactive isotopes of which phosphorus ( $^{32}\text{P}$ ) is the most important. Even more striking has been the development of numerous chemicals which in many cases are more convenient to use and more versatile than ionising radiations.

These chemicals are not empirical discoveries. They are a rational development in the sense that they are specifically designed to interfere with the process of cell division so far as we understand it. The reason for designing drugs to interfere with mitosis is that this is one of the processes of cell growth which is clearly seen to be different in normal and neoplastic tissues. In addition it is a process that we have some power to alter, so that it seems reasonably certain that studies on these lines will continue for some time. There are numerous theories how cell division can be interfered with, and ideas at the moment are coming faster than we can work them out and test them. It also follows that it is most unlikely that many of the drugs we use today will survive for long. We can be fairly certain that they will be replaced by something better, and that we may soon look back on these drugs as we do on "Prontosil" and M. & B. 693 in relation to contemporary sulphonamides. Nevertheless they have their practical uses today which should be known, and it is wise to keep at least a nodding acquaintance with a type of treatment that is likely to develop in the future.

## RADIOMIMETIC DRUGS

These drugs act by interfering with mitosis and the results are similar in greater or lesser degree to the well-known effects of ionising radiations. These are as follows.

If applied in low dosage to normal cells, growth is interfered with so that atrophy, hypertrophy and other disorganisation results. In higher doses the cells are killed. In certain circumstances the cells are so altered that they are no longer under the influence of the factors which in any organism must control the growth of its tissues: the cells then grow autonomously and the tissues they produce are recognised as cancers. If applied to germ cells, sterility will result from high dosage, but with lower dosage genetic mutants are produced. If applied to neoplastic tissues themselves, then they are disorganised so that they are no longer as viable in the host and varying degrees of retrogression will be seen.

The intimate mechanism of these changes is not known, but it is a reasonable

speculation that in all cases a mutation is produced by altering chromosome structure. The result is that the descendants of an affected cell behave differently from the normal.

We are familiar with the idea of mutations in *germ* cells and realise that however often they may occur they can only be recognised if they allow both fertilisation and growth, and so are able to cause some recognisable abnormality in the offspring. It is possible that mutations occur with equal frequency in *somatic* cells. These would be most easily recognised if the mutation was such that it removed the cell from normal control of the organism, for the descendants would then grow excessively and autonomously—and become cancers. A lesser release from control would be shown by atrophy, hypertrophy and disordered growth—processes which are well known clinically to be precancerous.

There are a large number of methods by which some or all of these effects can be produced. Apart from ionising radiations they include ultra-violet and infra-red radiations, a large range of chemicals, infection with viruses, chronic inflammation from various causes, increased cell growth as a part of repair, natural and artificial hormone stimulation, and probably other things as yet unknown.

It is of course the synthetic chemicals that we are concerned with here. Whether the above speculations continue to prove useful or not, they at least fit in with the experience that any radiomimetic chemical that is therapeutic will also in varying degrees be toxic, carcinogenic and mutagenic. Theoretically this will always be so, and future improvements in this line can only be in the direction of stressing one quality at the expense of others.

Only in exceptional circumstances can radiotherapy produce a cure by permanent inhibition. The reticuloses are at first usually extremely radio-sensitive, but eventually they become completely resistant. The same is true for the chemical therapeutic agents. It has been suggested that any radiomimetic agent achieves its first success because the neoplastic tissues are composed almost entirely of the same genetic mutant. But when these cells are all dealt with, the field is left clear for other mutants which are resistant and which existed in small numbers before, or were developed spontaneously during treatment. This state of affairs is analogous to breeding resistant strains of bacteria under the influence of antibiotics. In a sense, therefore, a patient who eventually succumbs to a lymphosarcoma dies of a genetically different growth from the one that was previously successfully treated, just as a patient may die of a strain of tubercle bacilli, different from his original infection, which has been selectively bred as a result of treatment by streptomycin.

Something is known of the mechanism whereby these chemicals produce mutants. The first substance used was nitrogen mustard. This was an empirical discovery made while investigating the toxic effect of war gases. Interference with mitosis was seen similar to that following ionising radiations, and this suggested its possible therapeutic effects. Nitrogen mustard and its derivatives and other substances such as Triethylene-melamine (T.E.M.) have a molecular structure which contains certain reactive groups. These groups have the pro-

perty of causing other molecules to be linked together, or alternatively of interfering with a linkage which should normally occur. This linkage is important, for it is part of the chemical basis of the many microscopic and macroscopic structures with which we are familiar; or reversely, it may be the reason why on occasions these structures are imperfectly formed. These substances can be seen to interfere with mitosis in the stage at which the chromosomes should be split longitudinally and be drawn apart to form two new cells. It is, for instance, possibly these reactive groups which prevent the orderly splitting, and by disturbing the arrangement of the genes give mutants, somewhat like the classical observation of "cross over" linkage in *Drosophyla* flies.

It is interesting to note that substances of this kind are used in industry for linking molecules together to form textile fibres or sheets (*e.g.* paints). Some of these substances are carcinogenic. T.E.M. was introduced by the German paint industry and it was because of its property of molecular linkage that it was later used in cancer work.

### ANTIMETABOLITES

A different action is found in the case of 6 mercaptopurine (6M.P.) and the folic acid antagonists. These act by disorganising purine metabolism which is concerned with forming nucleo-proteins, the basic substance of the chromosome. The effect will again be seen on all cells in the body since the nuclear metabolism of reticulosis cells is very similar to that of the normal. The only reason that they have any useful effect is that the malignant tissues are affected first, because they are growing more actively. But the distinction is slight and effective therapy is always very near to fatal toxicity. They are not, however, in theory either carcinogenic or mutagenic. In practice this is no recommendation because the patient's life can only be measured in months by the time the use of these drugs is indicated.

6M.P. is a competitive antagonist of nucleic acid. It is sufficiently like it to be accepted and built into the macromolecular structure of the chromosome, but once there it does not function as such. The mechanism is similar to that of bacteria taking up the useless sulphonamide because it is like the essential metabolite para-aminobenzoic acid.

Aminopterin antagonises folic acid, which is a necessary enzyme in the synthesis of nucleic acid. Again, as would be expected, it has far-reaching effects in the rest of the body. The mechanism is analogous to the use of other anti-enzymes in medicine. Anticholinesterases (Neostigmine) and anti-carbonic anhydrase (Diamox) may be quoted.

### SPECIFICITY

In the account that follows, the various drugs are recommended for certain specific conditions. But although experience shows that this is their best use, their action is not at all specific: to some extent they are interchangeable. Further, at first sight they all appear to act specifically on diseased tissue as opposed to normal. This is not true. As has been explained, they are only

effective because they chiefly affect rapidly growing tissues, which means malignant tissue first and the hæmopoietic tissue a close second. It is the bone marrow that sets a limit to the dosage that can be used, and this dosage is never sufficient. None of these agents therefore is anything but a temporary inhibitor.

### DRUGS IN USE

*Radioactive phosphorus ( $^{32}\text{P}$ ).* This is to be considered as a much more discriminating applicator of ionising radiations than an X-ray tube. The isotope gives off  $\beta$  radiations which are only effective within a millimetre or so of source. Metabolically it behaves as phosphorus, so that its turnover, and therefore its effect, is greatest in actively dividing cells such as the bone marrow. The half-life of the isotope is about fourteen days, but the biological half-life is less as some is excreted in the urine.

It is now used almost exclusively for polycythæmia vera, for which it is by far the most effective and convenient treatment. When the blood count is made normal, the patient is surprised to find how well he feels as most of his annoying and sometimes disabling symptoms disappear. These include high colour, dizziness, tendency to bruise and bleed, thrombosis in veins and arteries, ulceration and gangrene of the toes, dyspepsia, gout and itching. Even if there are no symptoms the threat of a fatal or disabling thrombosis in the central nervous system is removed. In my view all cases should be treated unless there is a special contra-indication.

Many of these symptoms can be relieved by reducing the blood count by venesection. Removal of blood is, however, useless for long-term treatment because the red cells are still re-formed in quantity. The only difference is that there is now a relative shortage of iron, so that while the hæmoglobin may be normal the packed cell volume is still raised and the patient suffers all the symptoms except the high colour. The effect of  $^{32}\text{P}$  is to inhibit erythropoiesis and so keep the packed cell volume low for long periods.

In practice the count rarely falls too low, and this may be because we are chiefly inhibiting a sensitive malignant erythropoiesis, while leaving the normal process to continue as before. For the same reason, possibly, we have had no trouble with depressing leucocyte and platelet formation, which is normally very sensitive to radiation.

The phosphorus compound is given in solution by mouth or intravenously in doses to 5 to 15 mc. The administration, so far as the patient is concerned, is simple, but the preparation, standardisation and handling require special equipment and experience. Only a few doses are needed to bring the ordinary case under control; thereafter a booster dose every two years is usual. Some cases are difficult to deal with, but others only need one treatment every five years or so.

There has naturally been some question as to how dangerous this radioactive treatment is. Will it induce leukæmia, sterility, or genetic mutants? The final answer cannot yet be given. Leukæmia or, less commonly, aplastic anæmia are two of the natural terminations of polycythæmia, but so far as is known this tendency is not increased by treatment. We are naturally chary of using any

radioactive isotope treatment in patients who are fertile, but the dosage is believed to be safe, and in a few cases of doubt the patient's health takes precedence over theoretical possibilities of harm. Recently the first patient to be treated at the Royal Marsden Hospital died at the age of 80, having received a large dosage over the last seven years. Spermatogenesis was still in progress and the spermatozoa were histologically normal.

*Nitrogen mustard (Mustine B.P.).* Mustine has an inhibitory action on the reticulosos, but the side effects of vomiting and great misery hardly justify the slight benefit it confers, though it still remains the quickest method of reducing the size of the glands in Hodgkin's disease when they are, for example, blocking the superior mediastinum. The results were, however, sufficiently promising to stimulate the synthesis of a large number of derivatives, of which two are now in use Busulphan and Chlorambucil.

*Busulphan (Myleran, G.T.41).* This is used for chronic myeloid leukæmia. The dose is 4 to 8 mg. a day by mouth, and an effect will be expected on the blood count and visceral infiltrations in about two weeks. The return to normal is checked by leukocyte counts every week or so, and the dose is progressively reduced to 2 mg. or stopped when the count sinks to 10-20 thousand cells. A maintenance dose can be continued indefinitely.

At first there is nearly always a remarkable improvement, which, however, gets less as time goes on. Eventually the disease becomes resistant, or passes into the myeloblastic phase in which the drug has no effect. There is no statistical proof that life is prolonged, though this is often hard to believe when one sees the improvement in individual patients. Certainly life is made much more worth while living. These results are all very similar to those following radiotherapy, though in some cases they may be slightly better. The important point is that it is always more convenient.

*Chlorambucil (Leukeran, C.B.1348).* This is used for chronic lymphatic leukæmia, lymphosarcoma and follicular lymphoma. The dose is 8 to 16 mg. a day by mouth and an effect will be expected in two to six weeks. The drug continues to act for about ten days after stopping treatment. No course of treatment should exceed 500 mg. or permanent aplasia may result, but fresh courses may be started when the count rises again in the interval. The general effects are again similar to those of radiotherapy. It is not as easy to use as Busulphan.

*6 Mercaptopurine (6M.P.).* This is only used in acute myeloid and lymphatic leukæmia, or in the terminal "blast" phase of the chronic disease. The dose is 100-150 mg. per day by mouth and any effect should be seen in two to eight weeks. The drug must be pressed to the point of severe aplasia or no remission will occur. This needs close laboratory control. At the best, a few months' comparative comfort and prolongation of life may be obtained. The justification for its use is only that there is nothing better. No physician need feel that he has not done the best for his patient if he decides not to use this drug.

*The Folic Acid Antagonists.* Aminopterin and Amethopterin (Methotrexate). These are used almost exclusively for the acute leukæmias of childhood. They are given by mouth and, like 6M.P., must be pressed as far as severe aplasia.



This may occur suddenly in a few days so that very close laboratory control and experience are needed. At the worst they produce only a few weeks' improvement which are of no great significance in the life of a child and may raise false hopes in the parent. But sometimes the remission is hæmatologically complete for a time and the child may return to school and normal activities. Unfortunately this is never prolonged beyond a year or so.

*Triethylenemelamine (T.E.M.)*. This substance was extensively used in the United States after the war, but in this country the nitrogen mustard derivatives were preferred. It is certainly effective in chronic leukæmias, particularly the lymphatic type. But many patients have died of aplasia, produced by doses that were previously harmless. The explanation of this phenomenon appears to be that T.E.M. polymerises in the bottle and becomes inactive, so that the physician can never be certain what effective dose he is giving. It is still used in America, but now in smaller doses which do no harm, nor possibly much good. It is not recommended for practical use today and Chlorambucil or Busulphan should be used instead.

*Decacetylmethylcolchicine (Demicolcine)*. The autumn crocus (*Colchicum autumnalis*) is a versatile plant. It is decorative, it yields a yellow dye and a flavouring for cakes; it cures gout and can induce polyploidy in seeds of other plants so that races with larger flowers and fruit can be bred. It is this latter property that attracted attention in cancer work. Demicolcine is effective in chronic leukæmia, but only while producing vomiting and intolerable side effects, so that it has no practical value.

*Cortisone*. The use of this drug for the reticuloses may be compared with the use of morphine in other conditions. Neither is a specific cure, but since both produce numerous and profound changes in metabolism, they are potentially very versatile symptomatic remedies. How useful they prove to be depends entirely on the skill of the doctor who uses them. Cortisone in daily doses of 150-400 mg. may have the following effects. In the acute leukæmia of children it occasionally induces a complete hæmatological remission which has been known to last for several years. In the terminal stages of adult reticuloses it may lower temperature, increase weight and well being, and stop capillary hæmorrhages and hæmolysis. These effects are inconstant and always temporary. But they are invaluable in the terminal stages where nothing else is effective.

## CONCLUSIONS

1. Polycythæmia should be controlled by <sup>32</sup>P.
2. Chronic myeloid leukæmia can be effectively and safely treated with Busulphan by any intelligent doctor who has pathological facilities.
3. Chronic lymphatic leukæmia and lymphosarcoma can be effectively, but less easily, treated by Chlorambucil.
4. Leukæmia in children, acute leukæmia and the "blast" phase in adults can sometimes be temporarily halted by 6M.P. and Aminopterin. These drugs should not be used by the inexperienced, and are only worth while in cases where "everything possible must be done."

5. Cortisone is a safe and often valuable symptomatic remedy in the terminal stages of reticuloses.

6. Hodgkin's disease is still best treated by radiotherapy.

I wish to thank Dr. D. A. Galton of the Chester Beatty Research Institute for keeping me continually informed of these matters over the past ten years.

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### *Book Reviews*

A THERAPEUTIC INDEX. 2nd Ed. By C. H. Miller, M.D., M.R.C.P. and B. K. Ellenbogen, M.D., M.R.C.P. Pp. 156+xii. London: Baillière, Tindall & Cox, 1957. 12s. 6d.

The authors claim with some justification that their publication provides a ready guide to the treatment of many of the common and some of the less common conditions met with in medical practice. It is well and clearly written, stoutly bound and of a convenient pocket size. The references to various practical procedures are useful but could have been improved by a few simple diagrams. Deliberately unpretentious, this little book is of undoubted value to the busy general practitioner and the hesitant houseman.

H. P.

MEDICAL EFFECTS OF THE ATOMIC BOMB IN JAPAN. Edited by Ashley W. Oughterson and Warren Shields. Pp. 477+xvi. Illustrated. New York: McGraw Hill Book Co., 1956. \$8.

This volume (volume 8 in Division VIII) is another useful addition to the United States National Nuclear Energy Series. It will be extremely valuable to all those who wish to study the findings of the Joint Commission which investigated the effects of the atomic bombs in Japan. The authors and editors are to be congratulated on producing such a mass of information in one volume. The text is well illustrated. A list of the illustrations and a more detailed index would be of help since this book should be a very important source of reference.

A. R. T. L.

MEDICAL DEPARTMENT U.S. ARMY. SURGERY IN WORLD WAR II. Vol. II—General Surgery. Edited by Colonel J. B. Coates, Jr., M.C. Pp. 417+xxiv. Illustrated. Washington 25 D.C.: U.S. Government Printing Office, 1956. \$4.25.

Official medical histories of wars consistently attain a very high standard, and this is no exception. It should be read by all interested in military surgery and measured alongside our own publications on the subject. The part on resuscitation of the wounded in the field is well done and interesting.

A. G. D. W.

# A REVIEW OF 49 CASES OF LEUKÆMIA OCCURRING IN THE BRITISH ARMY DURING THE PERIOD JANUARY 1947 TO DECEMBER 1954

BY

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THE extensive medical literature on the subject of leukæmia includes the publication of many large series of cases—Ward (1917), Rosenthal & Harris (1935), Bethell (1943), Sacks & Seemon (1947), Gauld, Innes & Robson (1953). This review of a relatively small number of cases is presented not as an analysis of problems of ætiology or treatment, but to record the incidence and mode of presentation of leukæmia in the British Army during a definite period of time. Some remarks on the difficulties in diagnosis and treatment are included.

It was felt that the review of these cases would be best undertaken at The Queen Alexandra Military Hospital, to which many were transferred from other military hospitals both at home and abroad. This is in accordance with current policy which enables the Army Medical Service to obtain the co-operation of the Radiotherapy Department of the Westminster Hospital in the management of these cases.

The investigation commenced by an analysis of a list of cases classified as leukæmia by the statistical department of the War Office, and which occurred during the period January, 1947 to December, 1954. Excluding Gurkha troops, 57 such cases were found. There was no record of leukæmia occurring in female personnel during this period. We were able to obtain the original clinical notes or a medical report in 56 of these cases. Two cases were rejected because of the inadequacy of the clinical data. Of the remaining 54 cases, five were rejected as probably having suffered from diseases other than leukæmia, the likely diagnoses in these cases being reticulosarcoma, aplastic anæmia, glandular fever, Di Guglielmo's disease and ankylostomiasis.

The 49 cases remaining are those which the authors, after a careful perusal of the available evidence, considered to be proven cases of leukæmia. In 14 of these the diagnosis was substantiated by post-mortem examination. In others the diagnosis was confirmed by a personal examination of the blood and marrow smears. The remaining cases were included only after a careful scrutiny of the marrow reports, blood counts, and clinical details.

## TYPE OF DISEASE

Leukæmia is usually divided into acute, subacute, and chronic types, the classification being based either on the duration of the disease or on the cellular morphology and clinical picture. This series has been classified according

to the duration of the disease from onset of symptoms to death (Table 1). Cases dying within six months of onset of symptoms were classed as "acute," those which survived for twelve months as "subacute," while those which lived over twelve months were placed in the "chronic" group (Wintrobe, 1951). The correlation between this arbitrary method and the clinical and hæmatological picture was good. The separation of a "subacute" group will, we imagine, become of doubtful value now that remissions lasting several months may be obtained in "acute" cases with the aid of A.C.T.H., cortisone or the cortisone analogues. The large proportion of "acute" cases is accounted for by the preponderance of young adults in the army.

Table 1. *Classification of types of leukæmia occurring in this series*

Type of disease	No. of cases	Total
Acute : Myeloid	18	37
Lymphatic	10	
Monocytic	1	
Unclassified	8	
Subacute : Myeloid	—	1
Lymphatic	—	
Monocytic	1	
Chronic : Myeloid	10	11
Lymphatic	1	
Monocytic	—	

### INCIDENCE

In view of recent reports that the incidence of leukæmia is increasing it was considered that a record of the annual incidence in this series might be of value to future authors. The number of cases occurring in the years 1947 to 1954 was as follows:

1947 : 5(728,000)	1948 : 2(473,000)
1949 : 10(385,000)	1950 : 2(384,000)
1951 : 3(393,000)	1952 : 6(413,000)
1953 : 11(417,000)	1954 : 10(424,000)

The figures in brackets give the average yearly army strength (male and female) to the nearest thousand. These figures emphasise the rarity of the disease.

Because of the selected nature of the army population no conclusions could be drawn about the age incidence of the disease. The number of cases occurring in different age groups was as follows :

0-10 years : nil	11-20 years : 28
21-30 years : 15	31-40 years : 3
41-50 years : 2	51-60 years : 1

### MODE OF PRESENTATION

The commonest presenting symptoms were those of anæmia, oropharyngeal sepsis and bleeding (Table 2). These three have been grouped together as it

was often impossible to be certain from the medical documents which of these three was the initial complaint. The high frequency of this triad as a mode of presentation is in agreement with most text-book descriptions, but we would rather emphasise the unusual and varied manner in which the disease may present. An examination of Table 2 shows that this disease, especially in its acute form, may present in a variety of ways, from deafness to diarrhœa.

Table 2. *List of presenting symptoms*

Mode of presentation				No. of cases
Symptoms or signs of anæmia	}	...	...	22
Oropharyngeal infections				
Hæmorrhagic manifestations				
Respiratory tract infection	...	...	...	7
Left-sided abdominal pain (? splenic)	...	...	...	4
Routine examination (splenomegaly)	...	...	...	2
Thrombotic episodes	...	...	...	2
Pain and swelling of joints	...	...	...	2
Acute diarrhœa	...	...	...	2
Enlarged lymph nodes	...	...	...	1
Abdominal swelling	...	...	...	1
Malaise and loss of weight	...	...	...	1
Pyrexia of unknown origin	...	...	...	1
Pleural effusion	...	...	...	1
Deafness and tinnitus	...	...	...	1
Pain in back	...	...	...	1
Abscess of upper arm (following T.A.B. inoculation)	...	...	...	1

Twenty-four cases developed signs and symptoms of anæmia early in the disease and in fact six cases presented as an anæmia for investigation. In five of these an initial diagnosis of pernicious or megaloblastic anæmia was made, though it is clear from the notes of at least two cases that a diagnosis of leukæmia was under consideration at the time of the blood and marrow smear examinations. It was only when treatment with liver extracts or vitamin B<sub>12</sub> was ineffective, or when the physical signs or hæmatological picture had changed, that the true diagnosis was made. None of these cases was seen by the authors, but from a scrutiny of the clinical notes it seemed that the error arose in two ways. Firstly, an incorrect identification of the cells in the marrow smear arose from early myelocytes being mistaken for megaloblasts. Secondly, there appeared to have been a failure to contrast the clinical and hæmatological findings, as in none of these cases was the clinical picture at all typical of a pernicious anæmia or sprue. We consider that in any case of anæmia with an apparently megaloblastic bone marrow but with an atypical clinical picture, especially when occurring in a young person, the diagnosis of leukæmia should be carefully considered.

While discussing the difficulties in diagnosis we would emphasise the problem of differentiating leukæmia from the case showing a "leukæmoid" reaction to some other disease process. This differentiation is especially important now that cortisone and A.C.T.H. and their analogues are being used to treat leukæmia. One such case in which the true diagnosis of leukæmoid reaction to miliary tuberculosis was only established at post-mortem has been seen by us.

## COMPLICATIONS

The many complications of this disease are well recognised. Two of the more common groups are those due to a decreased resistance to infection and those due to a hæmorrhagic tendency, especially in the acute forms. The wide range of chemotherapeutic and antibiotic substances available have lessened the difficulties in treating the first group. The tendency to bleed remains a source of many distressing symptoms and forms an ever-present threat of serious internal hæmorrhage. In this series hæmorrhagic phenomena occurred in the early stages in 35 cases, 27 having either petechiæ or ecchymoses in the skin; 16 cases had epistaxis or bleeding gums or both, and fundal hæmorrhages were found in 12 of the 26 cases which were known to have been examined ophthalmoscopically. Three cases died suddenly of intracranial hæmorrhage. Recurrent epistaxes or bleeding from the gums, apart from aggravating any pre-existing anæmia, soon exhaust the patience of both patient and doctor. Plugging the nostrils and cauterisation sometimes help, as does leaving the nose strictly alone. We should like to note the method used by Lieut.-Colonel H. N. Perkins, R.A.M.C., in which a finger-stall attached to a small rubber catheter is inflated within the nose and left *in situ*. This is well tolerated by the patient, the application is easily performed and it usually stops the bleeding for at least several hours. The advent of steroid therapy may lessen hæmorrhagic complications in the acute form of the disease as, apart from the general clinical and hæmatological improvement frequently observed in these patients, the bleeding tendency is often reduced. This is in contrast to the action of the cytotoxic drugs.

## TREATMENT

Treatment with cortisone or A.C.T.H. (or more recently the synthetic corticoids, prednisone and prednisolone) is probably, at the time of writing, the best method of producing a remission in the acute form of the disease. In this series seven cases were given these drugs. Four were given A.C.T.H. intramuscularly in dosage 75-100 mg. daily, but in only one case was any significant improvement observed. Three cases were given cortisone by mouth. Two who had acute leukæmia were both improved. In one, the clinical improvement was unaccompanied by any significant change in either the total white cell count or in the percentage of immature forms. In the other acute case there was a dramatic improvement both clinical and hæmatological. This case was of a seriously ill man aged 50 years with acute lymphatic leukæmia. (Hæmoglobin, 6.2 g. per 100 ml.; white cell count, 19,500 per c.mm.; polymorphs 1%, lymphocytes 42%, monocytes 2%, eosinophils 2%, lymphoblasts 53%, platelets 21,000 per c.mm.) He was treated by blood transfusions, antibiotic therapy and cortisone by mouth in divided dosage: 300 mg. on the first day, 200 mg. on the second day and then 150 mg. daily. Although three days after the commencement of treatment his white cell count had fallen to 300 per c.mm. (nearly all lymphoblasts), he made a rapid improvement and within six weeks, while on cortisone 75 mg. daily, he felt well and had a blood picture indistinguishable from normal. A

fatal relapse occurred three months later. He was treated elsewhere and the effect of a second course of cortisone was not tried. The third patient to receive cortisone was a case of chronic myeloid leukæmia, in an acute phase. This had occurred in September, 1954, following an initial good response to radiotherapy to the spleen the previous April. Radiotherapy and busulphan (1 : 4-dimethane sulphonyloxybutane) were now ineffective. By the end of September, 1954, he was severely ill with pyrexia, epistaxes, purpura, enlargement of liver and spleen, ascites and polyarthritides. His hæmoglobin had fallen from 12.0 g. per 100 ml. to 5.5 g. per 100 ml. in two weeks. He was given blood transfusions and oral cortisone 100 mg. daily with marked improvement, so much so that seven weeks later, in December, 1954, he was able to go on sick leave. In February, 1955, cortisone dosage was gradually reduced and by March, 1955, was discontinued. Within two weeks he relapsed with anæmia, rising white cell count, fever, epistaxes, leukæmic skin deposits, and died despite treatment with busulphan and radiotherapy. In both these cases the results of treatment of the relapses with cortisone in high dosage would have been of interest as the drug is generally held to be ineffective at that stage.

The cases of chronic leukæmia responded normally to accepted forms of treatment.

### PROGNOSIS

The duration of life from the onset of symptoms in the acute cases varied from a few days to six months ; the average duration in the 30 cases which were not treated with either cortisone or A.C.T.H. was three months. The two cases treated with cortisone in this series lived for seven and eight months respectively. It will be interesting to compare the prognosis of future cases treated with steroid hormones with that for the 30 cases noted above.

### RELATION OF LEUKÆMIA TO ANKYLOSING SPONDYLITIS

Recently it has been suggested that leukæmia may occasionally occur as a complication of radiotherapy for ankylosing spondylitis (Van Swaay, 1950 ; Brown, Court & Abbott, 1955). In view of this it is important to know whether the two diseases are associated in the absence of radiotherapy. In this series of 49 cases of leukæmia no associated ankylosing spondylitis was diagnosed (as radiographs of the spine and sacro-iliac joints were not taken routinely, it cannot be stated more definitely that the disease did not occur). This series is too small for any conclusion to be drawn, but the figures may become of value in future investigations into this important matter.

### SUMMARY

1. A review of 49 cases of leukæmia occurring in the British Army during the years 1947 to 1954 is presented.
2. The yearly incidence, classification of the types of case, age incidence, mode of presentation and average prognosis are recorded together with some remarks on the difficulties in diagnosis, the complications and the treatment.



We wish to record our thanks to Mr. D. T. Beeston, Mr. Richards and the staff at A.M.D. Stats., and to Mr. White and the staff at the Ministry of Pensions, Norcross, for their help in tracing and providing medical documents, and to the officers commanding Military, R.A.F. and Naval hospitals for their prompt and helpful attention to our requests for medical documents.

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### Book Reviews

ANÆSTHETIC ACCIDENTS. By V. Keating, M.B., B.Ch., D.A., F.F.A.R.C.S. Pp. 261+vi. Illustrated. London: Lloyd-Luke (Medical Books) Ltd., 1956. 25s.

The recent investigations and report on the subject of Anæsthetic Deaths by the "Association of Anæsthetists" has drawn our attention forcibly to the manner and frequency in which they can occur. This book, therefore, arrives at a most opportune moment, being as it is a study of the accidents and complications of all types of anæsthesia together with recommendations for their prevention and treatment.

The chapters on the circulatory and respiratory complications are excellent and very full. Starting with the basic physiology and pharmacology of the system, he shows how they may be modified and upset by anæsthesia. In a similar manner he has dealt thoroughly with the complications of intravenous, local, spinal and endotracheal anæsthesia together with the complications associated with the use of relaxants and the neurological complications of general anæsthesia. Unfortunately the section on vomiting does not quite achieve the same high standard.

Dr. Keating was an anæsthetist in the Corps for many years and is to be congratulated on producing such an excellent book.

S. O. B.

X-RAY REPORTS, THEIR IMPORTANCE IN A DIAGNOSTIC DEPARTMENT. A MANUAL FOR RADIOGRAPHERS AND CLERKS. By G. Lieba Buckley, M.A., M.B., B.S., D.M.R.E. Pp. 72+vii. Illustrated. London: H. K. Lewis & Co. Ltd., 1957, 7s. 6d.

This comprehensive handbook undoubtedly fills a need by introducing a clerk to the technical terms in common use in an X-ray department, and, in a general way, to the work of the department itself. Too often a clerk in an X-ray department struggles with his duties in almost complete ignorance of the language used around him and of the reports which he copies and files. This book will be invaluable to a keen and intelligent man in this position.

A radiographer should possess the knowledge contained in the book, but even so, in his early months, he will gladly use it for reference.

T. M. C.

# PENICILLIN IN THE TREATMENT OF 84 CASES OF LEPTOSPIROSIS IN MALAYA

BY

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LEPTOSPIROSIS is not a single entity but an infection caused by several different serotypes of leptospira (W.H.O., 1956), of which there are numerous varieties in Malaya.\*

Conflicting opinions are held as to the therapeutic value of penicillin in leptospirosis. Highly optimistic views were expressed by Smith (1949) about the bactericidal and bacteriostatic action of penicillin on leptospiræ. He emphasised that penicillin should be administered within the first four days, during the septicæmic stage, and before toxic nephritis developed. Fairburn & Semple (1956), however, treated 21 cases of leptospirosis with 2,400,000 units of penicillin daily and concluded that penicillin was of no value in the treatment of this disease. Trimble (1957) appeared to hold similar views. Doherty (1955) studied 111 cases of early leptospirosis due to a variety of serotypes and found that the duration of the fever was significantly shorter in the 45 cases who had received more than 800,000 units of penicillin daily. Varfolomeeva (1951) treated 47 cases of leptospirosis without jaundice, the majority due to *Leptospira grippotyphosa*, with a total daily dose of 360,000 units of penicillin for four to five days and obtained a complete cure if treatment was begun before the fourth day of disease and modification of the illness when treatment was started between the fourth and seventh day. Referring to penicillin in leptospirosis, Broom (1953) noted that physicians very often recorded clinical improvement after its administration. Many individual cases and small series of the infection have been reported, and when the time of commencement of penicillin therapy and the dosage were comparable the results on the whole have corresponded with those of Doherty. Obviously, detailed knowledge of the natural course of the infection in humans due to each serotype would be of great value in assessing the efficacy of any therapeutic agent. What is of even greater importance in this assessment of the therapeutic value of penicillin in leptospirosis is the size

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\* *L. australis* A; *L. autumnalis*; *L. bangkinang*; *L. batavica*; *L. benjamin*; *L. canicola*; *L. celledoni*; *L. djasiman*; *L. grippotyphosa*; *L. hebdomadis*; *L. hyos*; *L. icterohæmorrhagica*; *L. javanica*; *L. ledanensis*; *L. poi*; *L. pomona*; *L. pyrogenes*; *L. saxkoebing*; *L. sentot*; *L. wolffii*.

and frequency of the dosage as well as the day on which such therapy was instituted. We suggest that the reason that some workers have reported disappointing results from penicillin therapy in leptospirosis is that insufficient importance has been attached to these points. In this communication we report on the diagnosis and treatment with penicillin of 84 cases of laboratory proven leptospirosis in Malaya.

### MATERIALS AND METHODS

All cases were drawn from the security forces in Malaya and consisted of 41 United Kingdom troops and 43 Gurkhas. They had all been living in jungle camps or had been engaged on jungle patrols, and in fact 81 (96 per cent) of all cases first reported sick within ten days of returning from jungle patrol. The remaining three were living in jungle camps.

As far as possible, all male febrile cases admitted to B.M.H., Kinrara, were admitted to one ward. The medical officer in charge of that ward had been specially briefed in the diagnosis of leptospirosis and all febrile cases were seen by him as soon as possible after admission. The intention was that the provisional diagnosis of leptospirosis should be made, penicillin therapy instituted, and all relevant investigations begun within 24 hours of admission to hospital. This was achieved in 65 (77 per cent) of all laboratory proven cases of leptospirosis seen. Furthermore, out of 90 cases provisionally diagnosed and managed as leptospirosis, the laboratory subsequently confirmed the diagnosis in 84 cases.

All patients were sent to convalesce in the temperate climate of B.M.H., Cameron Highlands, at about the third to fourth week after the onset of their illness. On their return to B.M.H., Kinrara, they were reviewed and sent back to their units.

#### *Cultural methods*

Three tubes containing Fletcher's sterile rabbit serum on agar were used for each patient. One drop of blood was inoculated into each tube with sterile precautions. One tube was examined after 10 days' incubation and if no growth occurred the two remaining tubes were not examined until 28 days had elapsed. Because of the frequency of contamination an attempt was made to read the tubes before this became obvious.

#### *Serological methods*

Thirty millilitres of blood were taken initially. The serum was separated and stored in the cold, using one drop of 5 per cent sodium azide as a preservative. A second specimen was taken between the fifteenth and twentieth day of disease or immediately prior to discharge of the patient to convalescence. In positive cases a third specimen of serum was required late in convalescence to assist in the identification of the species of infecting leptospira. Such specimens normally had to be obtained direct from the regimental medical officer and were not requested as a routine.

A complement fixation test was performed at the United States Army Medical Research Unit, Kuala Lumpur, and was considered diagnostic of leptospirosis if the second specimen showed a fourfold rise in titre over the first. It cannot be regarded as specific, however, for the individual species of leptospira.

A leptospiral agglutination test was performed at the Wellcome Laboratories of Tropical Medicine, London. Although not usually regarded as species-specific on acute and early convalescent sera owing to the occurrence of cross-reactions, it often becomes specific when applied to late convalescent sera, on about the ninetieth day of the illness, by which time heterologous antibodies will usually have disappeared, leaving only homologous antibody.

According to Broom (personal communication) the agglutination technique used by the Wellcome Laboratories in diagnosing Malayan cases of leptospirosis is different from the ordinary diagnostic test for cases occurring in the United Kingdom, where only *L. icterohæmorrhagiæ* and *L. canicola* occur, because of the variety of species involved and the number of sera in which cross-reactions appear. Twenty serotypes are now tested by Broom, and the routine method used involves preliminary testing of the second sample of serum in a dilution of 1 in 100 against each of the twenty serotypes. If no agglutination occurs, the patient is considered as not suffering from leptospirosis. If the second sample gives a positive result with any of the antigens used, both first and second samples are tested against each of the serotypes with which the second reacts. If the first specimen is completely negative, or has a much lower titre than the second, a report "Positive for leptospirosis" is returned, provided that the second sample reacts to a dilution of at least 1 in 1,000 with one or more serotypes. If as sometimes happens both specimens are positive they usually react to about the same titre and with only one or two serotypes. Such cases are reported as positive, but it is suggested that the titres represent the residual antibodies from a previous infection and have no significance as far as the patient's present illness is concerned.

*Routine investigations.* Examinations of blood films for malaria were performed on all febrile cases and a specimen of urine was tested routinely. In addition, every patient had a total and differential white blood count performed and a radiograph of the chest taken. E.C.Gs. were done in selected cases (*vide infra*).

## CLINICAL DIAGNOSIS

### *Symptoms*

All cases complained of feverishness and 'flu'-like symptoms including headache, chills, generalised muscle pains, vomiting, cough, rigors and abdominal pain (see Table 1). Diarrhœa was a presenting symptom in four cases in the early stages of the disease and occurred in three cases within 24 hours of commencing treatment with penicillin. In one case diarrhœa began on the ninth day of the illness after five days of treatment. In all, 7 per cent of cases treated had severe diarrhœa, and in no case were pathogens discovered in the stools.

### Signs

Conjunctival injection was present in 80 cases (95 per cent), muscle tenderness in 47 cases (56 per cent), generalised lymphadenopathy in 36 cases (43 per cent), tenderness in the upper right abdominal quadrant in 34 cases (40 per cent), adventitious signs in the chest in 23 cases (27 per cent), hepatomegaly in 15 cases (18 per cent), neck stiffness in 13 cases (15 per cent), splenomegaly in five cases (6 per cent) and herpes labialis in three cases (3.5 per cent). Towards the end of our series we noted œdema of the conjunctivæ in many patients, but as this sign had not been noticed before we were unable to assess its frequency throughout the series.

We would like to stress three points in the diagnosis of leptospirosis, in the absence of jaundice and hæmorrhage, shown by our series. None of our cases had the exquisite muscle tenderness reported by other observers; 95 per cent of our cases had obvious conjunctival injection, and rashes other than petechial hæmorrhages were not noted in a single case. On diagnosis, all cases felt and appeared ill and this was a striking feature when compared with other cases admitted to hospital with pyrexia of unknown origin.

Table 1. *Common symptoms in leptospirosis*

Day diagnosis was made	No. of cases	Fever	Head-ache	Chills	Rigors	Generalised muscle pains	Abdominal pain	Vomiting	Cough
2nd	4	4	4	2	2	3	2	2	1
3rd	15	15	15	12	2	9	0	6	2
4th	25	25	25	22	2	13	4	6	5
5th	26	26	26	22	4	16	4	12	10
6th	14	14	13	8	3	10	1	4	6
Total	84	84	83	66	13	51	11	30	24

## COMPLICATIONS

### *Hæmorrhagic Phenomena*

In 17 cases (20 per cent) hæmorrhages were present and in 10 of these they appeared shortly after penicillin therapy was commenced. In seven cases hæmoptysis occurred alone, in six hæmatemesis occurred alone, and in four hæmoptysis and hæmatemesis occurred together. In one case of hæmatemesis there were associated bleeding per rectum, epistaxis and petechial hæmorrhages into the skin. In one case of hæmoptysis there was associated epistaxis. In this series, hæmorrhages were not observed before the fourth day of the disease unless administration of penicillin had started.

### *Jaundice*

Eighteen cases had jaundice. This appeared on the third day of the disease in two cases, on the fourth day in five cases, on the fifth day in seven cases and after the sixth day in four cases. It is interesting to note that jaundice became apparent shortly after the institution of penicillin therapy in several cases.

Five cases with icterus had associated hæmorrhages and these were seriously ill, the jaundice lasting 28 days. The remaining 13 cases ran a mild course and the average duration of icterus was seven days.

### *Urinary Changes*

Of a total of 71 cases (84.5 per cent) which showed albuminuria or cylinduria while in hospital, 67 had urinary abnormalities on admission; 40 had albuminuria alone, whilst the remaining 27 showed cylinduria in addition. Four other cases developed albuminuria during their stay in hospital between the fifth and seventh day of illness.

There were five cases with anuria, which we defined as a condition when two ounces or less of urine are excreted in 24 hours. In two cases, admitted on the third and fourth day of the disease, anuria was present on admission. Of the remaining three cases, two were admitted on the fifth day and a third on the sixth day of the illness. All three became anuric following the commencement of penicillin therapy. The two cases admitted on the fifth day of the disease started penicillin within 24 and 48 hours of admission respectively, while the case admitted on the sixth day of the disease commenced penicillin three days after admission.

Four of the cases of anuria had associated jaundice and hæmorrhage. No case developed polyuria of low specific gravity following the anuric phase, as is frequently observed in cases of anuria following infections for which no specific cure is available, *e.g.* epidemic hæmorrhagic fever in Korea. It is noteworthy that all cases of anuria showed low systolic blood pressure, but no cardio-vascular stimulants were given as this might have precipitated sudden death.

### *Radiography of the chest*

In every case a radiograph of the chest was taken on admission, and further, films were taken if hæmoptysis occurred or abnormal physical signs appeared in the chest. Thirteen per cent of all cases had abnormal chest radiographs of which three showed generally increased lung markings while eight showed bilateral mottling particularly at the bases. All cases in which mottling had been present during the acute stage had normal films after 10 days. In one case, showing mottled shadows, hæmoptysis was absent, while three cases with hæmoptysis had normal chest radiographs.

### *E.C.G. changes*

The occurrence of myocarditis has been reported in leptospirosis (Dragert, 1934; Ashe, Pratt-Thomas & Kumpe, 1941; Sutliff, Shepard & Dunham, 1953), and for that reason, and because of past experience of collapse and death within hours in leptospirosis, we decided to obtain E.C.G. tracings in some cases. Bertucci (1945), referring only to Weil's disease due to *L. icterohæmorrhagiæ*, stated that the electrocardiogram occasionally showed prolonged QT and PR intervals, defective AV conduction, functional or real incomplete AV



# STANDARD E.C.G. LEADS OF CASE 1.



3rd day of disease showing ventricular extra-systoles tachycardia and low T waves in I and II, inverted T wave in III with a low voltage tracing.

12th day of disease showing almost complete reversion to normal tracing.

PLATE I



blocks, low T waves, blocked auricular beats, sinus tachycardia and low voltage QRS complexes, these changes being reversible during convalescence. Other workers report evidence of myocarditis on post-mortem examination.

Serial E.C.Gs. were performed on 10 of our cases. Four of these were selected on the grounds of clinical indications of myocardial disease, as shown by severe prolonged hypotension and irregularities of the pulse. The remaining six cases were consecutive admissions with uncomplicated leptospirosis of moderate severity. In all cases the first tracing was taken shortly after treatment with penicillin was started. A second tracing was taken during the stage of recovery, and in the case of abnormal results a third was obtained during convalescence.

The four patients with clinical signs of myocardial disease all showed E.C.G. evidence of myocarditis and are described below.

*Case 1.* Third day of disease. Gurkha soldier. Low voltage tracing with frequent ventricular extrasystoles and low T waves in leads I and II (see Plate I). By the twelfth day of disease the tracing had returned to normal.

*Case 2.* Fifth day of disease. Gurkha soldier. Low voltage tracing with widening of the QRS complex (0.14 secs.) and low T waves in lead II and all V leads. By the seventh day of disease the tracing showed the T waves to be approaching normality and by the fourteenth day of disease the E.C.G. was normal.

*Case 3.* Fifth day of disease. British soldier, aged 21. Low voltage tracing with low T waves in Leads I and II. Normal by the fourteenth day of disease.

*Case 4.* Fourth day of disease. Gurkha soldier showed auricular fibrillation together with widening of the QRS complex and depressed T waves in all leads. Fibrillation lasted for eight hours and the E.C.G. returned to normal by the tenth day of disease.

Of the six consecutive uncomplicated cases, two showed minor irregularities of the QRST complex on the fifth day of the disease, which returned to normal by the seventh day. The remaining four cases showed no E.C.G. changes other than sinus tachycardia.

#### *Blood count*

In all cases there was a relative or absolute polymorpho-nuclear leucocytosis with a total white cell count varying from 4,100/c.mm. to 20,300/c.mm. The average white cell count was between 8,000/c.mm. and 9,000/c.mm.

#### *Cerebro-spinal fluid*

Lumbar puncture was performed on three occasions and the cerebro-spinal fluids found to be normal.

#### *Severity of cases*

The illness was considered to be severe when serious complications such

as multiple hæmorrhages, severe myocarditis and severe jaundice or anuria occurred (see Table 2).

Table 2. *Cases classified according to severity*

Day of disease on which treatment started	Number of cases	Severity of illness	
		Mild	Severe
2nd	4	3	1
3rd	15	11	4
4th	25	22	3
5th	26	25	1
6th	14	10	4

### RESULTS OF SPECIAL INVESTIGATIONS

Blood culture was positive in 29 per cent of cases, of which six were taken on the third day, eight on the fourth day, nine on the fifth day and one after the sixth day of the illness. We are unable to assess accurately the results of the complement fixation test (CFT) as towards the end of this series the antigen used gave inconsistent results.

In 39 per cent of cases the agglutination reaction (AGR) alone was positive, while in 25 per cent of cases the CFT and AGR were positive in the absence of a positive blood culture. In six cases the CFT was the only positive finding when the second specimen of serum for the AGR was damaged in transit. Only in one case was the CFT positive when both blood culture and AGR were negative. The presence of a positive CFT makes the diagnosis certain, but on occasion this test may be negative when other tests are positive (see Table 3).

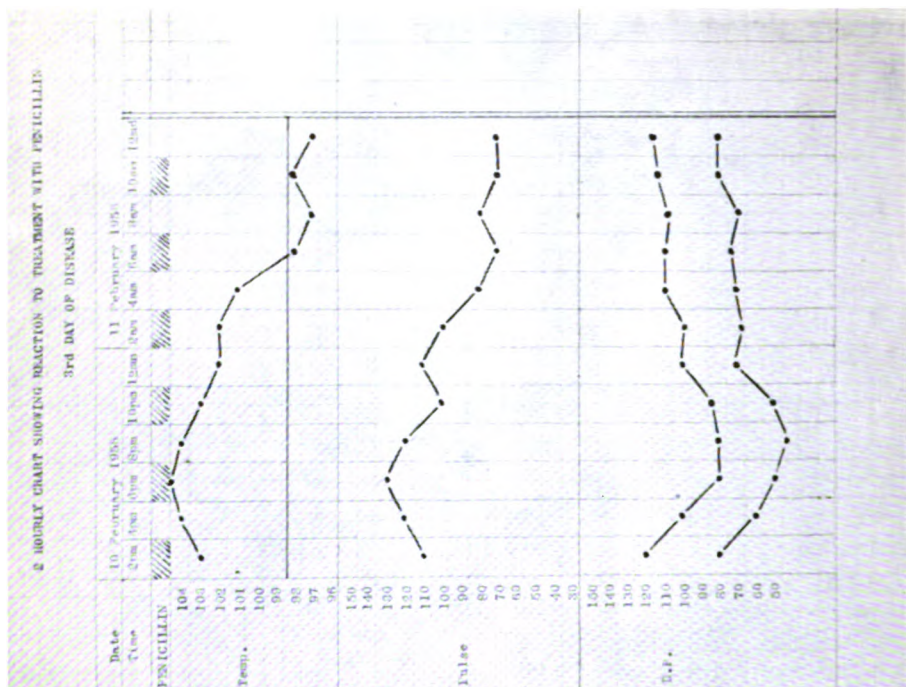
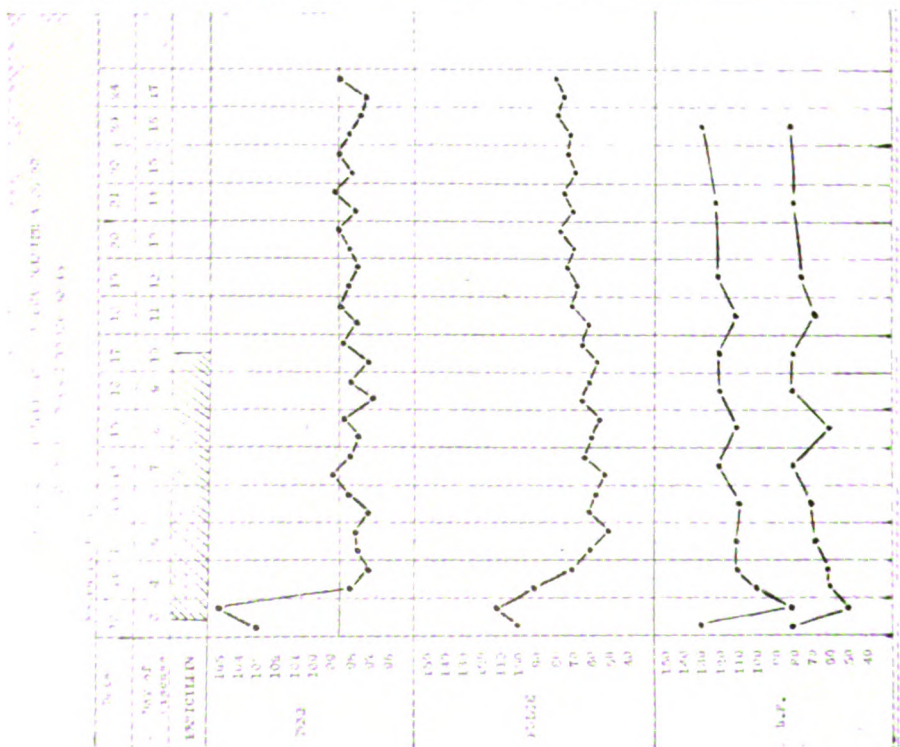
Table 3. *Results of blood culture, complement fixation test (CFT) and agglutination*

No of cases	Blood culture	CFT	AGR
12	Positive	Positive	Positive
6	Positive	Negative	Positive
5	Positive	Negative	Not done*
1	Positive	Positive	Not done*
32	Negative	Negative	Positive
21	Negative	Positive	Positive
6	Negative	Positive	Not done*
1	Negative	Positive	Negative

\* The AGR was not performed in these cases as the bottle containing the second specimen was broken in transit.

It should be mentioned that in several cases where the blood culture was positive the AGR titre in the second specimen was not diagnostic. Broom agrees that these must be regarded as true cases of leptospirosis in which the production of antibodies is unusually slow, and possibly the earlier administration of penicillin may explain this phenomenon. Furthermore, one patient had a second attack of leptospirosis, due to a different species from the first, after





Daily and 2-hourly charts showing response to Penicillin.  
Note the effect on the temperature, pulse rate and blood pressure.

an interval of months and both attacks responded dramatically to penicillin therapy.

In another case with a positive blood culture, serological tests showed that the culture reacted to titre with antisera from both *L. bataviæ* and *L. medanensis*, both being unrelated antigenically. Broom is of the opinion that the possibility of a concurrent infection with the two serotypes cannot be excluded.

### OUTLINE OF TREATMENT

The aim of treatment was to maintain adequate hydration and electrolyte balance, to relieve headache and pain with pethidine and to commence penicillin therapy as soon as possible.

It was calculated that obviously dehydrated patients required 6 per cent of their body-weight as fluid replacement. Half of this fluid was given by continuous intravenous drip as normal saline and half as 5 per cent dextrose in water in the absence of renal impairment. In the presence of vomiting, equivalent volume of normal saline was given by intravenous infusion. The average daily basic requirement was assessed as three litres of fluid in 24 hours, one-sixth of this was given as normal saline and five-sixths as 5 per cent dextrose in water. Where the patient had oliguria due to impaired renal function the régime was modified accordingly.

The initial dose of penicillin was 600,000 units given intramuscularly, and this dose was repeated four-hourly for 24 hours and then six-hourly until the seven days therapy had been completed.

All five cases of anuria were managed with a régime first described by Bull, Joekes & Lowe (1949) and did well. Three patients who developed anuria before this series was started would not tolerate this régime. In these, however, we restored a reasonable state of hydration and electrolyte balance intravenously. We gave two pints of 40 per cent glucose in water by continuous infusion through polythene tubing into the inferior vena cava. All three patients survived although two had been dangerously ill and had hæmorrhagic manifestations and deep jaundice.

### EFFECTS OF PENICILLIN THERAPY

When penicillin was given before the sixth day of the illness the duration of the fever was reduced from an average of about 34 hours to one of about 18 hours. At the same time the symptoms were ameliorated (see Plate II).

When penicillin was given on or after the sixth day of the illness no reduction in the period of pyrexia was observed, although in individual cases the symptoms were relieved and the fever fell more rapidly than in untreated cases.

#### *Clinical reactions to penicillin therapy*

Within four to six hours of the first dose of intramuscular penicillin, 70 (83 per cent) of all cases and 89 per cent of those treated within five days of the onset of the illness had a reaction similar to that described by Jarisch and Herxheimer. Of these 70 cases, 59 had a sharp rise in temperature while 58

had a marked fall in blood pressure. In addition, in 31 cases there was a precipitation or aggravation of the classical symptoms and signs of leptospirosis. The reaction was mild in 60 and severe in 10 affected cases.

Some alarm was caused by the collapse and appearance of these patients, but penicillin therapy was continued and no additional treatment prescribed. Within 24 hours the patients had completely recovered from their reaction, the duration of which approximately equalled that of the pyrexia following the commencement of penicillin therapy.

This type of reaction has been noted elsewhere during penicillin therapy for leptospirosis (Crooks & Blair, 1955) so that we neither ceased nor modified the antibiotic therapy. We came to regard this reaction as an indication of a good response to treatment and as a useful diagnostic sign in leptospirosis. It is now known in this hospital as the "Diagnostic Penicillin-Leptospiral Response."

We noted that during the hours immediately following the onset of the reaction, a high specific gravity oliguria occurred in all cases except in the three who became anuric. Once the blood pressure returned to normal, the urinary output did likewise without the passage of persistently low specific gravity urine.

The average duration of hypotension was 24 hours, although in cases in which penicillin therapy was started after the fifth day of the illness, the blood pressure was rather low before treatment (averaging 110/70) and slowly returned to normal within seven days (see Tables 4 and 5).

Table 4. *Penicillin Leptospiral Response (P.L.R)*

Day of disease on which treatment was begun	Total No. of cases	No. of cases showing a P.L.R.	Percentage showing P.L.R.	Severity of P.L.R.	
				Mild	Severe
2nd	4	4	100	3	1
3rd	15	13	86	8	5
4th	25	22	88	19	3
5th	26	23	88	23	0
6th	14	8	57	7	1

Table 5. *Nature of P.L.R.*

No. of cases showing sharp rise in temperature	Average temperature	No. of cases showing fall of blood pressure	Lowest blood pressure recorded	No. of cases in which symptoms or signs were precipitated or aggravated by penicillin
3	105° F.	3	90/60 mm. of Hg.	3
11	105° F.	13	90/60 mm. of Hg.	10
16	104° F.	20	80/50 mm. of Hg.	8
22	104° F.	17	80/50 mm. of Hg.	4
7	103° F.	5	80/50 mm. of Hg.	6

An additional feature noted in our patients was the absence of prolonged impairment of the concentrating power of the kidney, which had been a frequent complication in the past in patients not receiving penicillin. In the experience of one of us (J. M-D) it was not an infrequent occurrence in cases of lepto-

spirosis not treated with penicillin for a relapse to occur during the third week of the illness, so that patients were never sent to convalesce before the end of the third week. Such relapses were characterised by a sudden steep rise of temperature, associated with rigors of varying degree and a recrudescence of some of the symptoms and signs of leptospirosis. Within 24 to 36 hours the temperature returned to normal and the patient again became symptom-free.

Our findings indicate that penicillin given within five days of the onset of leptospirosis has a definite therapeutic value. We also believe that penicillin should be given no matter on what day of the disease the patient comes under medical care. The dramatic response of the illness seen in patients treated earlier is absent in these late cases, but it is felt that relapse will be avoided. In addition, penicillin may also prevent any prolonged impairment of renal concentrating power.

### DISCUSSION

In assessing the therapeutic value of a drug in a given infection, an understanding of the natural history of the disease produced by the infecting agent in humans is essential, together with a detailed knowledge of the early symptomatology and presenting signs.

Pathogenic leptospiræ are known to occur particularly in the mud and swamps of the Malayan jungles, so that the patient who had returned from jungle patrols and living in jungle camps was suspect, especially as malaria and typhus were improbable when the soldier had taken normal precautions.

We believe that the early clinical diagnosis of leptospirosis is not difficult, despite the fact that in this hospital, where there is an awareness of the problem and excellent hospital laboratory and local research facilities, 30 per cent of all febrile cases admitted do in fact suffer from a mild infection of as yet unknown ætiology.

The patient suffers from a sharp, febrile, 'flu'-like illness with obvious conjunctival injection, sometimes associated with œdema of the conjunctiva. In addition he may complain of vomiting and abdominal pains, as well as muscle pains and tenderness. On examination he may be jaundiced, with or without hepatomegaly, or show only some upper abdominal tenderness, general lymphadenopathy and vague signs in the chest. Relative or absolute polymorphonuclear leucocytosis is invariable, and malaria is excluded by repeated thick and thin blood smears.

Within 24 hours of admission to hospital, albuminuria is present in 80 per cent of cases, and in our experience a febrile patient from a leptospiral environment with suggestive symptoms and albuminuria should be diagnosed provisionally as suffering from leptospirosis and the urinary signs not dismissed as febrile albuminuria. This point has been previously stressed (Mackay-Dick & Watts, 1949).

The frequency of radiological signs in the chest was interesting to note, especially in the absence of hæmoptysis, but in all cases the signs disappeared after 10 days.

Of the 90 cases provisionally diagnosed as leptospirosis, 84 (93 per cent) were proved in the laboratory. Although we should be content with this high diagnostic rate, we noted that several of the six remaining cases showed a response following penicillin and we are not convinced that the provisional diagnosis was false even though the blood culture, CFT and AGR were all negative. As we have shown, the blood culture can be positive, and yet with early penicillin therapy the rise in antibody titre may be below the diagnostic level unless very late specimens are examined. As blood culture was negative in 71 per cent of cases it will be appreciated that a negative or doubtful positive AGR in the second specimen of serum in cases treated early with adequate doses of penicillin may not exclude a diagnosis of leptospirosis.

We were particularly interested in the therapy of the illness and stress that immediate attention should be given to the degree of water and electrolyte depletion, their remedy and the maintenance of proper hydration and electrolyte balance. In the presence of anuria the routine was to adopt the Bull régime, and this was satisfactory in our five cases presenting this complication. Should this not have proved satisfactory we had intended to give one litre of 40 per cent glucose into the inferior vena cava every 24 hours, which had proved life-saving in three previous cases (Russell, Dewhurst & Brace, 1954).

With skilled hydration and attention to the electrolyte balance alone, we believe that all but fulminating cases of leptospirosis should recover, provided that the significance of hypotension and myocarditis is recognised and no attempt is made to prescribe cardiac stimulants. Can we therefore claim that penicillin is of therapeutic value in the treatment of leptospirosis in Malaya? We have demonstrated that the duration of the fever is reduced to about half and that symptoms are relieved when this therapy is begun within the first five days of illness. In those cases treated after the first five days none showed any impairment of the water concentrating power of the kidney either early or late in the illness, and there were no relapses; nor did any of the remaining 70 cases show such features. This is in contrast to the experience of one of us (J.M-D.) when not using penicillin in the treatment of leptospirosis, when all febrile cases who developed persistent impairment of the water concentrating power of the kidney were suspected of having leptospirosis and relapses in the third week were not infrequent.

Past experience of hypotension in patients suffering from leptospirosis suggests that cardio-vascular stimulants have no place in the treatment of this complication. The presence of jaundice called for no additional special therapeutic measures in the early stages. Attention was paid to the accepted dietetic principles when the patient was out of danger.

#### SUMMARY

Details are given of the diagnosis, management and treatment of 84 consecutive cases of laboratory proven leptospirosis affecting security forces in Malaya. The presenting symptoms and signs of the cases are reviewed and the importance of albuminuria in the diagnosis stressed.



The incidence of radiological changes in the lungs is noted. Attention is drawn to the presence of myocarditis in some cases and the importance of avoiding treating this complication with cardio-vascular stimulants.

Leptospirosis should be managed by careful maintenance of the water and electrolyte balance, together with early treatment with large doses of penicillin. 600,000 units of crystalline penicillin were given four-hourly on the first day and the same dose six-hourly for a further six days. This halved the duration of the fever and cured symptoms rapidly when given in the first five days of the illness, prevented any relapse and eliminated the danger of persistent impairment of renal concentrating power in all cases.

We suggest that large doses of penicillin should be given in all cases of leptospirosis no matter how long the diagnosis is delayed.

We wish to express our acknowledgment of the help we have had from the following : Major R. M. Vanreenan, R.A.M.C., Pathologist, B.M.H., Kinrara, and D.A.D.P., Malaya Command, for many of the laboratory investigations as well as his observations on leptospirosis in Malaya in 1950, when he did not have the advantages of the diagnostic facilities so readily available to us now ; the Commanding Officer and Officers of the Medical Research Unit of the United States Army based on the Institute of Medical Research, Kuala Lumpur, for performing the Complement Fixation Tests and for their cordial co-operation at all times ; the Medical Director and Staff of the Institute of Medical Research, Kuala Lumpur, for advice and access to their library ; Captain R. P. M. Urquhart, R.A.M.C., for sending us many references on this subject and for extracts from the literature ; Major I. M. Carmichael, R.A.M.C., for the radiological investigations together with Dr. M. R. J. Snelling, Physician Superintendent, The Lady Templer Tuberculosis Hospital, Kuala Lumpur, for help in their interpretation ; our colleagues in the R.A.M.C., especially the regimental medical officers who referred these cases to us with commendable speed and judgment ; Q.A.R.A.N.C., Student Nurses and R.A.M.C. Orderlies, who all played their part in the investigations and treatment of these cases ; Dr. J. C. Broom, O.B.E., M.D., of the Wellcome Laboratories of Tropical Medicine, for performing the agglutination tests and for his most valuable guidance ; to Lieut.-General Sir Alexander Drummond and Major-General W. D. Hughes for encouragement and help ; and finally, to Captain P. R. Holt, R.A.M.C. for valuable suggestions in the arrangement of this paper.

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# PARTIAL GASTRECTOMY FOR PEPTIC ULCER

## A REVIEW OF 181 CASES AMONG BRITISH MILITARY PERSONNEL

BY

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### INTRODUCTION

DURING the five years 1950 to 1954 no fewer than 2,222 serving personnel were invalided from the army with a diagnosis of peptic ulcer. This figure includes all medical and surgical cases.

Not long ago a soldier who developed a chronic peptic ulcer was invalided and his army career thus came to an end. This was a serious matter both for him and the army. The army today, however, requires a soldier to be a highly skilled individual, often with a long and expensive technical training behind him, and it becomes all the more urgent to keep him fit and retain his services.

This review has been carried out in an effort to discover whether the results of partial gastrectomy in the army justify the retention of the soldier as a practical and economic proposition as regards both the time taken and the standard of health regained. It is also important to show that the standard of surgical skill in the army is high and compares favourably with that found in civil life.

While this individual review reveals the absence of a fully organised follow-up system in Army Records, there is sufficient material from which definite conclusions can be drawn. Owing to necessary postings no individual remains in the same station for sufficient time to allow a long-term follow-up of the results of such a major branch of surgery. It would seem right, therefore, to suggest that the material gathered for this review should be kept and added to and reviewed again after a period of time by some interested successor.

### METHOD

This review covers a five-year period from the beginning of 1950 to the end of 1954. All military hospitals were asked to submit a nominal roll of patients who had undergone a partial gastrectomy for peptic ulcer during this period together with a résumé of their case histories. While this information was being gathered, the "present location" or "the last known address" of each patient was found by reference to the Unit Record Offices so that a follow-up questionnaire might be sent to the patients concerned.

Several difficulties at once became clear. Some hospitals which were known to have had such cases nevertheless submitted a "nil" return. In some instances case notes could not be obtained. Some Record Offices were unable to give the "present location" for security reasons, but were willing to forward any communication. Thus direct contact was lost, with all the added waste of time and loss of personal interest. "The last known address" sometimes proved unreliable, for, having left the army, a patient often changed his address upon getting a new post.

It must therefore be admitted that the exact number of operations is not

accurately known. Nevertheless a total of 227 cases were notified. Of these, 46 cannot be included, being incomplete for one or other of the reasons given above. Thus 20 per cent of the material known to exist is wasted from a research point of view, leaving 181 cases for study.

*The follow-up questionnaire.* The questions were so worded and arranged that the patient gave his own assessment of the clinical result. In addition, a space was left in which the patient's own doctor recorded his independent opinion, placing the patient into one of the four grades described below. Thus a very fair general assessment is made without the bias of any individual or panel. The four grades were :

1. Excellent.
2. Improved.
3. No change.
4. Worse.

To be "Excellent" the patient had to be completely symptom-free without any restrictions in diet and working capacity. To be "Improved" he had to be able to do a full day's work, but suffered from minor symptoms readily amenable to simple treatment. Those in the "No change" group still had symptoms similar to those before operation or post-gastrectomy symptoms bad enough to keep their working capacity unchanged. Those in the "Worse" group had symptoms so severe that their working capacity was definitely reduced and they remained under treatment.

## RESULTS

Ogilvie (1953) states: "What should we ask of gastrectomy for the simple ulcer? The mortality should be negligible, well under 1 per cent, with a cure rate of at least 90 per cent. The remainder are not symptom-free, but they find the symptoms they are left with a small price to pay."

Table 1

Authority	No. of cases	Excellent	Improved	Good*	No change	Worse	Poor†	Died
Finney <i>et al.</i> (1930)	34	Not stated	Not stated	88.2	Not stated	Not stated	11.8	Not stated
Pulvertaft (1952)	632	59.0	23.0	82.0	15.0	3.0	18.0	Not stated
Rauch (1952)	893	26.4	63.6	90.0	Not stated	Not stated	10	2.7
McDonald <i>et al.</i> (1953)	Not stated	Not stated	Not stated	82.0	4.0	4.0	8.0	Not stated
Ogilvie (1952)	Not stated	93	5.6	98.6	Not stated	Not stated	1.4	2.7
Tanner (1954)	91	59.6	32.2	91.8	3.3	4.9	8.2	1.0
Goligher <i>et al.</i> (1956)	312	48.5	37.0	85.5	7.0	3.4	10.4	4.1
British Army (Present Series) (1954)	181	64.2	26.9	91.1	7.4	1.5	8.9	2.7

\* "Good" includes "Excellent" and "Improved."

† "Poor" includes "No change" and "Worse."

To gauge the success or failure of the work done in the army, it is necessary to compare the results with this statement and with similar series done by other institutions or individuals. This has not proved easy, for although there are abundant statistics available, the standards used to gauge the results vary greatly. Indeed, in some cases it has been necessary to deduce figures from published results and to present them in two different ways in order to make comparisons fair and clear. The most readily comparable figures are presented as percentages in Table 1.

It will be seen that the British Army figures compare very favourably with the best in civil life both in this country and in America.

**Mortality.** The mortality of 2.7 per cent was made up as follows :

Burst duodenal stump ...	...	...	...	2
Leaking anastomosis ...	...	...	...	1
Massive collapse of lungs ...	...	...	...	1
Pulmonary embolus ...	...	...	...	1
				—
Total ...				5
				—

Three of these deaths must be attributed to the operation. The case notes concerning the man who died of massive collapse of the lungs suggest that death may have been due to anæsthetic difficulties. Pulmonary embolus is, of course, incidental to many different operations.

The civilian figures in Table 1 are the results produced by teams or individuals working in units accustomed to doing large numbers of gastric operations. The British Army figures are all the more interesting in that they reflect the work of no fewer than 33 different surgeons working in places as far apart as Japan and Northern Ireland. In fairness it must be stated, however, that the majority of the series were operated on in The Queen Alexandra Military Hospital, Millbank.

As the British Army figures compare well with the best in civil practice, it is important to co-relate them with the final "Pulheems" classification of the patients. Lengthy pamphlets explain the details of this method of grading, so that only a brief description is included here.

This method of grading is used by all three Services and indicates the degree of functional ability of the individual. "P" indicates the overall physical standard, "U" the degree of function of the upper limbs, "L" that of the lower limbs, "E" "E" the acuity of vision, and "M" and "S" the mental state. Each entity is graded from 2, indicating full, normal functional capacity to 8, which indicates a degree of disability requiring invaliding.

A lowered degree of function in any of the entities will invariably reflect on the "P" standard. Certain minimum standards are laid down for the various arms of the Service.

The final "Pulheems" classifications of the 181 cases are set out in Table 2.

Table 2

Final grading	Number of cases	Percentage
P2	109	60.2
P3	22	12.2
P6	5	2.7
P7	22	12.2
P8	18	10.0
Died	5	2.7

One hundred and fifty-eight patients (87.3 per cent) remained in a serving category and 109 (60.2 per cent) were fit for front line service in any part of the world within a year.

It is of some interest to note how the different ranks responded to treatment. The results are recorded in Tables 3 and 4, classified both according to the civilian and Pulheems methods.

Table 3

Results (per cent)—Civilian classification						
	No. of cases	Excellent	Improved	No change	Worse	Died
Officers ...	56	73.0	14.4	3.6	1.8	7.2
N.C.Os. ...	101	58.4	32.7	6.9	1.0	1.0
Other ranks ...	17	41.2	35.3	23.5	0	0
Females ...	7	85.7	0	14.3	0	0

Table 4

Results (per cent)—Pulheems classification							
	No. of cases	P2	P3	P6	P7	P8	Died
Officers ...	56	65.8	10.8	1.8	7.2	7.2	7.2
N.C.Os. ...	101	58.4	12.9	3.0	15.8	8.9	1.0
Other ranks ...	17	47.0	17.7	0	11.8	23.5	0
Females ...	7	71.4	0	14.3	0	14.3	0

It is unwise to draw definite conclusions from such a small series, but it would appear from both sets of figures that the officer group had the best prognosis, the other ranks the worst, while the N.C.Os. were intermediate.

*Type of operation.* The types of gastrectomy recorded for the patients under review were as follows :

Antecolic Polya	...	...	...	...	103
Retro-colic Polya	...	...	...	...	44
Unspecified	...	...	...	...	25
Billroth	...	...	...	...	9
Total	...				181

Many sets of figures have been produced in favour of the different methods of doing this operation. The fact that they show that one operation benefits some patients but not others also indicates that no one operation benefits them all. In other words, each has its place. Unfortunately there is not as yet any certain way of knowing which is most suitable for any particular patient. It would be unwise, therefore, to limit the army surgeon to any particular type of partial gastrectomy. The above figures show the Polya type to be the most popular. It is important that further reviews should check the subsequent Pulheems classification of the cases included in this survey. Only thus is it possible to confirm that a soldier or officer can properly be classified P2 (fit for full active service in any part of the world) after he has undergone an apparently successful partial gastrectomy for peptic ulcer. With this object in view a register of all the patients having this operation has been compiled.

*Complications requiring further surgery.* The complications recorded in the 181 cases under review were as follows :

Reactionary hæmorrhage (due to slipped ligature)	...	...	...	...	...	1
Internal hernia	...	...	...	...	...	1
Stomal ulcer	...	...	...	...	...	3
Incisional hernia	...	...	...	...	...	4
Burst duodenal stump	...	...	...	...	...	1
Bilious vomiting	...	...	...	...	...	1

### CONCLUSIONS

The surgical results in the army compare well with those in civil practice. This survey does not cover a long enough period to determine whether an officer or soldier still in a serving category should ever be properly graded P2. The fact that well over three-quarters of the cases are still in a serving category and over half are fit for full active service duties in any part of the world at the end of a year suggests that partial gastrectomy for chronic peptic ulcer is an economic proposition in the army.

The operation should be reserved for the Regular soldier and only done on the National Service man in cases of emergency. At present the operation should only be done in the United Kingdom. The Pulheems Joint Service System of Medical Classification, para 94 (b) (i), 1951, rules that following partial gastrectomy a patient will remain in P7 for one year. This is not a foreign service grading. If such an operation were done abroad the patient would have to be returned to the United Kingdom in any case. Furthermore it is in the interests of the patient as well as those of the Service that such a major operation should be done by a few really experienced surgeons rather than by many "occasional gastrectomists."

All cases who have undergone this operation should be reported to a central authority for follow-up purposes. Further follow-up studies may indicate that the present Pulheems ruling as regards patients who have had this operation requires revision.

I am grateful to Major-General J. Huston, Q.H.S., F.R.C.S., Director of Surgery, for his advice and encouragement and to Captain G. Tate, R.A.M.C., and Mr. A. E. Pridham, for their help.

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## COLD AGGLUTININS IN THE WEST AFRICAN SOLDIER

BY

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NORMAL sera may contain not only iso-agglutinins but also agglutinins which have a strong reaction at low temperatures and hence are known as cold agglutinins (Whitby & Britton, 1953). Cold agglutinins usually disappear on dilution of the serum beyond 1 : 16 or 1 : 20 (Turner & Jackson, 1943). They may, on occasion, be of high titre and also active at room temperature. This is a cause of mistakes in blood transfusion procedures. The titration of cold agglutinins has been found to be a useful laboratory procedure in the diagnosis of virus pneumonia, hæmolytic anæmias, Raynaud's disease and other conditions.

During a medical survey in a Gold Coast village, Colbourne, Edington & Hughes (1950) noted the frequent occurrence of cold agglutinins. This investigation has been undertaken following a suggestion by Dr. G. M. Edington, of the Medical Research Institute, Accra, that it would be useful to have a base line of cold agglutinins in normal West Africans. One hundred sera from normal West African soldiers were therefore examined.

## METHODS

The sera were separated from blood specimens which had been kept in an incubator at 37° C. overnight. Doubling dilutions of the sera were prepared in 75 mm. × 12 mm. Kahn tubes, using 0.2 ml. quantities. Pasteur pipettes, calibrated to deliver 0.2 ml., were used. A 1 per cent suspension of washed red cells from normal group O subjects was made from oxalated blood, which had been kept at 37° C. for four hours, and 0.2 ml. was added to each tube.

Results were read as follows :

1. After standing at room temperature for four hours.
2. After refrigeration overnight at 2° to 5° C.
3. After incubation at 37° C.

The room temperature was found to be on the average about 26° C. It was found difficult and often impossible to read cold agglutination because as soon as a tube was taken out of the refrigerator, dew immediately formed on the outside, making the glass opaque. This difficulty was overcome by dipping the tubes in a beaker filled with alcohol.

Readings were taken macroscopically using the concave side of a microscope mirror. Positive results were easily detected in most cases by the rough edge of the deposited cell suspension, as against the more uniform button of cells in the negative tubes. The titres recorded refer to the highest serum dilutions before the addition of red cells, at which macroscopic agglutination was observed.

Readings were also taken microscopically in 32 sera ; it was found that the microscopic titre was the same as the macroscopic in 3 cases, one tube higher in 16, two tubes higher in 7, and three tubes higher in 6 specimens. The microscopical readings necessitated quick work and special arrangements. A microscope, without a mechanical stage, was placed on a table beside the refrigerator. Glass slides were cooled in the refrigerator. To read the titre a tube was taken out, shaken three times, and its contents tipped quickly on to the edge of a cold glass slide ; the latter was then placed under the microscope. Once the first slide had been focused the adjustment and manipulation of the microscope were minimal, thus ensuring speed in reading cold agglutination. Comparison was made with a saline suspension of cells as a negative control ; a positive serum was also included in each batch of tests.

## RESULTS

No agglutination was seen at room temperature or at 37° C. in any of the sera. At 2-5° C. 51 sera gave positive results (see Table 1). One serum sample showed a "zone" phenomenon in that it gave a stronger reaction at a titre of 1 in 32 than in lower dilutions. One case of what appeared to be agglutination at room temperature was found to be rouleaux formation when examined microscopically.

Table 1. *Number of sera giving macroscopic agglutination at titre shown.*

Titre	No. of Sera
1/64	2
1/32	2
1/16	4
1/8	11
1/4	16
1/2	11
1/1	5
Negative :	49
Total examined :	100



## SUMMARY

One hundred sera were examined for the presence of cold agglutinins in the West African soldier. Cold agglutinins were found in 51 sera out of 100 examined. The highest titre recorded was 1 in 64. No agglutinins were found at room (26° C.) or incubator (37° C.) temperature.

I would like to thank the Director of Pathology for his advice, and Dr. G. M. Edington for his encouragement.

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## TRAUMATIC HÆMATOMA OF THE LARYNX

BY

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A SOLDIER aged 20 years was admitted to the B.M.H., Nicosia, during the evening of 2nd April, 1956, following a fall in which his neck had struck the mushroomed end of a metal tent-peg. The immediate effects of the injury were aphonia, a paroxysm of coughing with hæmoptysis, lancinating left otalgia and, according to his statement later, a sensation of "something running down into his chest." On admission thirty minutes after the accident his general condition was good although he appeared anxious and slightly dyspnœic (respiratory rate 30/min.). As he was unable to tolerate indirect laryngoscopy, a provisional diagnosis of laryngeal hæmatoma was made. 1,000,000 units of crystalline penicillin were given intramuscularly, followed by 500,000 units eight-hourly.

*3rd April.* Seen at 0830 hours. Dyspnœa was more marked and tracheostomy was advised in anticipation of increasing laryngeal obstruction. 0900 hours—transferred to the theatre. While waiting in the theatre a paroxysm of coughing occurred, followed by complete laryngeal obstruction with extreme cyanosis, carpo-pedal spasms, opisthotonus and finally collapse. A low emergency tracheostomy was performed immediately. This particular operation was selected to minimise the risk of laryngeal perichondritis at a later date. (Subsequently he developed an inhalation pneumonia which responded rapidly to penicillin and intensive breathing exercises.) Indirect laryngoscopy was performed daily. Initial examination showed complete immobility of the vocal cords and arytenoids, almost a cadaveric picture. A large hæmatoma involving the left ary-epiglottic fold and left arytenoid was present, protruding anteriorly over the posterior third of the left cord. A small hæmatoma was situated on the right cord at the junction of the anterior two-thirds and posterior third.

*11th April.* Nine days after the injury, the right cord was moving through 80 per cent of its range whilst the left cord had commenced slight movement on phonation.

*12th April.* Coughing occurred during the night and expectoration produced a discoloured piece of mucous membrane—roughly triangular in shape (3.5 cm. high and 1.5 cm. wide at its base). No hæmoptysis occurred. Laryngoscopy showed that the mucosal surface of the left arytenoid and left ary-epiglottic fold had been detached, leaving raw surfaces with a velvet-like appearance.

*13th April.* Right cord swinging across the midline on phonation but left arytenoid remains immobile.

14th April. Minimal movement of the left arytenoid and cord apparent on phonation. Œdema gradually subsiding. Voice husky.

16th April. Movements of left cord complete on respiration and phonation.

17th April. Evacuated by air to the United Kingdom.

### DISCUSSION

This case is described to underline the difficulties encountered with a mild case of dyspnœa which suddenly became a grave emergency. These difficulties can be resolved in a surgical unit, but the problem to a regimental medical officer is a serious one. There is a great temptation to evacuate immediately to hospital any case of mild respiratory distress whether from trauma, acute anterior poliomyelitis, diphtheria, foreign body or burns of neck, etc. The following suggestions may be used as a guide :

1. If indications for tracheostomy are present the operation must be performed prior to evacuation.
2. If there is little risk of laryngeal obstruction it is justifiable to evacuate the patient providing that the regimental medical officer is free to travel with the patient and is prepared to operate *en route* if necessary. It should be remembered that even very short journeys may become prolonged under adverse conditions.

### SUMMARY

A case of complete loss of laryngeal function due to trauma with recovery in two weeks is described. The management of such a case in the field is outlined.

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### *Book Review*

PYE'S SURGICAL HANDICRAFT. Edited by Hamilton Bailey, F.R.C.S. 17th Ed., Pp. 816. 860 illustrations. Bristol: John Wright & Sons, September, 1956. 52s.

Six years have elapsed since the last edition of this famous book. In this, the seventeenth edition, new knowledge and techniques have been skilfully inserted into the text without disturbing the well-known order of the contents or increasing the size of the volume. There are new chapters on "Treatment of Shock," "Management of Œsophageal Cases," "Management of Gangrene of a Limb," and "Ileostomy and its Management." The chapter on "Saline and Other Infusions" has been rewritten under the title "Establishing and Maintaining Fluid and Electrolyte Balance."

This book is a veritable mine of useful and practical information and should be in the possession of all junior medical officers.

P. F. M.

## EDITORIAL

### ASIATIC INFLUENZA

MUCH publicity has been given in recent weeks, in the Press and on the radio, to the epidemics of influenza which have occurred in the Far East. It has been shown that a new strain of virus A is responsible for these infections. Virus strains from many sources have been examined in London, Melbourne and Washington and shown to be identical with the type strain, known as A/Singapore/1/57, which is antigenically distinct from all strains previously isolated.

The part played by the Army Medical Services in the early isolation of the new virus has received scant recognition. Hong Kong was the earliest place outside the "iron curtain" to suffer from the disease, which became epidemic there in mid-April, and prompt action was taken at the outset by the medical officers concerned and the D.A.D.P. who dispatched throat swabs from cases to the Virus Laboratory at the Royal Army Medical College. A strain of influenza Virus A was isolated there and sent to the World Influenza Centre, Mill Hill, for identification. This was the first strain of the new virus received at the World Influenza Centre, and further confirmation of its identity was provided by the examination at the Royal Army Medical College of paired sera from cases in Hong Kong which showed rising titres of antibody to influenza Virus A, which includes the Asian virus. Singapore was affected by the disease soon after the Hong Kong epidemic and there the new virus was isolated by the civilian Consultant Bacteriologist to the Army in the Far East.

Reports suggest that the disease is mild and lasts only a few days. It is characterised by severe headache, general pains and fever lasting for two or three days, followed by about four days' disability. It has spread widely throughout the Far East and evidence of the infection was obtained from cases on troop ships returning to the United Kingdom last July and August.

Many outbreaks of a similar nature have been reported recently in this country especially among Service personnel and schools. From several instances Influenza Virus A has been recovered and in some cases its identity with the Asian type has definitely been established. The Virus Laboratory, Royal Army Medical College, continues to be fully engaged in the investigation of these infections.

The Committee on Clinical Trials of Influenza Vaccines, on which the Army Medical Directorate is represented, has been conducting trials of vaccines. Among the volunteers taking part in these trials were R.A.M.C. personnel from the Field Training Centre at Mytchett.

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#### ERRATUM

In the article Exercise "Medical Deucalion" in the July, 1957 number, page 128: 9th line from foot of page: for "rotund" read "orotund".

## *Matters of Interest*

### ROYAL SOCIETY OF HEALTH

#### HEALTH CONGRESS AT FOLKESTONE, 1957

THE Annual Congress for 1957 of the Royal Society of Health (which may be more familiar under its old title of The Royal Sanitary Institute) was held in agreeable surroundings at Folkestone from 30th April to 3rd May. As usual, the programme was a crowded one and it was often difficult to choose which meeting to attend ; one of the War Office representatives found it very difficult on the last day to choose between a talk on "Mental Hygiene in Marriage," which by all accounts was very good, and a meeting of the Tropical Hygiene Section, which proved to be excellent.

Professor Garnham, as President of the latter section, opened the proceedings with a fascinating survey of the zoonoses and their animal reservoirs. He was followed by Lieut.-Colonel M. L. Ahuja, Medical Adviser to the High Commissioner for India in the United Kingdom, who gave an outstanding paper on Rabies Control in India, during which he mentioned several names, such as that of Semple, which are familiar in military medicine. The second paper was given by Dr. Waddy of the Ross Institute and dealt with Frontiers and Disease in West Africa ; this also was a good paper and stimulated discussion. It was good to see the prominent part taken in the organisation of this section by the A.D.M.S., Home Counties District, and his staff. The disappointing feature of the meeting of the Tropical Hygiene Section was the poor attendance ; a notable visitor, however, was Professor Zhdanov, Deputy Soviet Minister of Health, who joined in the discussion in creditable English.

The Conference of the Medical Officers of Health took the form of a symposium on the Health of the Adolescent, a subject of interest to all who have to deal with the young soldier. Dr. Martin Herford, who holds an appointment as Appointed Factory Doctor and is also a member of the School Health Service, spoke on "The Adolescent in the Factory." Dr. Herford gave distinguished service in the R.A.M.C. during the last war and has since had much experience of the impact of National Service on young men ; his firm opinion is that few are harmed and many are helped by the experience.

Other interesting meetings dealt with Food and Nutrition, Absenteeism in Industry, Hospitals (understandably, perhaps, one of the liveliest) and World Health. The Health Exhibition contained much of varied interest, including a demonstration of modern motor ambulances. The Army School of Health again provided one of the most popular stands, the subject being Food and Nutrition in relation to the Army. The presentation of the material, which showed amongst other things the ration of the soldier from Roman times to the present day, reflected great credit on those responsible.

Interesting visits were to Wye College (Department of Agriculture of London University), where modern dairy practice and pure milk production were demonstrated, and to the near-by Veterinary Laboratories of the Ministry of Agriculture. It was perhaps the remark of a speaker at the Inaugural Meeting, "When I look at this vast gathering of people, I wonder whether we are doing enough for the health of animals," that sent the writer to Wye ! Certainly he received there an impressive demonstration of what is being done. Home Counties District had also arranged a visit to show methods of physical training.

All in all, the Congress was a very worth-while occasion, not least for the interesting contacts made with representatives of the other Services and of the civilian health authorities.

#### THE INTERNATIONAL WORKSHOP

AN interesting and unique exercise was carried out at the Royal Army Medical College on 9th July, 1957. A team of American instructors led by Dr. F. William Sunderman, Director of Research, Jefferson Institute, Philadelphia, and Captain Vernon E. Martens, Director, Department of Pathology, Bethesda Naval Medical School, U.S.A., came to

this country to demonstrate a Practical Seminar or Workshop in Clinical Pathology. Such a seminar has never been attempted in this country before and it is gratifying that the Association of Clinical Pathologists of Great Britain and Ireland, who sponsored it, selected the Pathology Department of the Royal Army Medical College for its venue.

A body of United States Naval Medical Technicians were flown over for the occasion and they transported and set up their apparatus with great speed and efficiency. Electric balances were lent by Messrs. Griffin and George. On the day of the meeting some fifty members of the Association of Clinical Pathologists were welcomed to the College by the Professor of Pathology on behalf of the Commandant, and a greeting by the Director-General, Army Medical Services, appeared on the programme. Two R.A.M.C. officers, Lieut.-Colonel P. D. Stewart and Major R. P. Bradshaw, took part in the seminar, and the Professor of Pathology and his staff were present throughout the proceedings.

The seminar took the form of an exercise in clinical hæmoglobinometry, and the students under their instructors performed mercury calibration of pipettes, analysis of iron, analysis of oxyhæmoglobin and spectroscopic examination of hæmoglobin solutions.

The object was to demonstrate methods used to obtain meticulously accurate standards for hæmoglobin estimations, without which results vary from laboratory to laboratory. Such standards can only be obtained by electrical weighing and spectroscopic checking of standard solutions prepared with the greatest care.

On the eve of the exercise a small dinner party was held by the group at the Café Royal, and amongst the guests was Colonel L. R. S. MacFarlane, O.B.E., M.D., Professor of Pathology, Royal Army Medical College. The Director of Pathology was unable to be present. After the exercise the members of the Association of Clinical Pathologists and their wives entertained the group to dinner at the Royal College of Surgeons. Other guests included several distinguished American pathologists and the Director-General, Army Medical Services, Sir Alexander Drummond, and Lady Drummond, and the Commandant of the Royal Army Medical College, Major-General W. D. Hughes and Mrs. Hughes.

The whole occasion was a most happy event occurring as it did in the fiftieth anniversary year of the Royal Army Medical College.

### **FIRST INTERNATIONAL HOSPITAL EQUIPMENT AND MEDICAL SERVICES EXHIBITION, 1958**

For the first time suppliers and manufacturers of hospital equipment have an opportunity of exhibiting under one roof. The First International Hospital Equipment and Medical Services Exhibition is to be held from 5th to 10th of May, 1958, in the Empire Hall, Olympia.

The Institute of Hospital Administrators is sponsoring the exhibition, and the annual conference of the Institute will be held within the exhibition.

The conference, which will be held over three days, will be attended by some 500 senior hospital administrators, secretaries and treasurers of Regional Hospital Boards, and senior officials of Hospital Management Boards. There will also be delegates from overseas.

The exhibition is given particular importance by the strong opinions recently expressed by doctors, hospital administrators and Members of Parliament on the need for improved hospital buildings and facilities in this country.

Even now there is more money being spent on the provision of hospital services than ever before, £20,000,000 per year, and for the first time the country has something approaching a hospital building programme.

This opportunity for the officials responsible for the administration of funds and purchase of equipment to see the full range of supplies available, both from Great Britain and overseas, coincides with a big campaign to put the hospital system of the country in first-class order.

Details of the exhibition are available from Contemporary Exhibitions Ltd., of 40 Gerrard Street, London, W.1.

### EX-SERVICES MENTAL WELFARE SOCIETY

Ex-SERVICES *Mental Welfare Society* is the new name of the Ex-Services Welfare Society which was founded in 1919 to help all ex-members of Her Majesty's Forces and the Merchant Navy suffering from war psychoses and neuroses.

Commenting on the change of name, Commander F. W. Lipscomb, O.B.E., R.N., of the Society, said: "The Council of the Society has decided on this change of name because of the more enlightened trend of public opinion. We want the public to know exactly what role we play in assisting the war disabled. This role covers both mental and nervous breakdown, but for simplicity only the word 'mental' was added to the title.

"The basic problem is this. In the Boer War the maximum casualties were from typhoid, but medical science overcame this. In the First World War open wounds caused most casualties, but again this danger has been largely overcome by the wonderful work of blood donors and surgical skill. In the last war due to the increased shock and violence of war, it is now generally accepted that the maximum casualties were from mental and nervous breakdown. Moreover there is a latent effect so that fresh cases are still coming in which means, of course, that the Society must remain on a war footing.

"In such cases as those that we deal with the time factor is frequently a vital one. None of us likes delay when we are ill and least of all the person suffering from nerves. Delay can sometimes be a terrible thing. We hope that a change of name will enable the public to contact us more quickly whenever they feel it is necessary."

The address of the Society is: Temple Chambers, Temple Avenue, E.C.4. Tel. FLEet Street 3712.

### OFFICERS WHO HAVE OBTAINED HIGHER QUALIFICATIONS SINCE 1st JANUARY, 1957

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Lieutenant J. Garfield ...

Lieutenant J. M. Barron ...

#### M.R.C.P.(Ed.)

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Lieut.-Colonel W. G.

MacFie ...

Major R. G. MacFarlane...

Captain C. G. B. Downie

Captain R. S. Williams ...

Captain I. G. Johnson ...

#### M.R.C.P. (J)

Major T. J. Ryan ...

#### M.D.(Ed.)

Lieut.-Colonel P. D.

Stewart ...

#### M.R.C.O.G.

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Captain A. B. L. Peake ...

#### F.F.A.R.C.S.

Major C. D. Sanders ...

Captain D. A. Walmsley ...

N.S.

N.S.

N.S.

Reg.

Reg.

Reg.

Reg.

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S.S.R.C.

#### D.P.M.

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Major A. F. Young ...

Reg.

#### D.T.M. & H.

Captain R. E. Worsley ...

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Major J. P. Crowdy ...

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Captain W. T. Richardson

Reg.

#### D.I.H.

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Capt. A. J. Shaw ...

S.S.R.C.

Lieutenant D. C. Pearson

S.S.R.C.

#### F.D.S. R.C.S.

Lieut.-Colonel J. H.

Reg.

Robertson, R.A.D.C. ...

Reg.

## *Book Review*

**HISTORY OF THE SECOND WORLD WAR. THE ARMY MEDICAL SERVICES. CAMPAIGNS.**  
Vol. I. By F. A. E. Crew, F.R.S. Pp. 637+xlili. Illustrated. London : H.M.S.O.,  
1956. 75s.

This is the first volume of four which will describe the campaigns of the Army Medical Services in the Second World War. It deals with events in France, Belgium, Norway, the Middle East, Malta and Madagascar during the years 1939 to 1943.

The narrative is concerned with the operational rather than the purely professional aspects of the Medical Services' task. It is unfortunate, therefore, that, owing to the slowness in appearing of the volumes of the Official Military History, those parts of the present volume which deal with operations may differ from the story which is finally told.

The short précis with which each chapter begins are, however, only intended to give the general background to the medical story, a function which they fulfil very well; it seems unlikely that they will ever have to be radically modified.

The general pattern of the book is this : a sketch of the general background to events in each chapter is followed by a detailed description of the activities of the Medical Services, and this in its turn by a valuable account of the health of the troops.

The medical operational story is often given in great detail, but the pages which describe the movements of medical units, with the help of only a few inadequate maps, are sometimes difficult to follow. The tactical handling of medical units, at least at divisional level, is not particularly difficult, and little is to be gained by the average reader from attempting to follow it in detail. More might have been included on the lines of the excellent review (pages 374-380) of the work of the forward medical units in the Western Desert, which is based on the account given in the Indian Official Medical History (provisional narrative). Another excellent account, which is not obscured by the accumulation of abbreviations and unnecessary detail, is that of the activities of the Long Range Desert Group.

This attempt to build up a coherent picture from the detailed movements of field medical units and sub-units is the main weakness of the book. Those movements, described in detail, appear exceedingly complicated, and yet they are part of the simple pattern presented by the line of medical evacuation. When the narrative treats broadly of the whole, and draws lessons without attempting to follow the travels of minor units, then it is most successful. Fortunately, throughout the book there are many pages of such narrative. Those which deal with the health of the troops and the lessons of the various campaigns are uniformly good and will be of great value in the future.

Minor errors must occur in a long book dealing with matters of such complexity. The reviewer was distressed to find, for example, the 20th (Bhopal) Field Ambulance referred to throughout as Indian 20th Field Ambulance; even worse, the credit for supporting Brigadier Slim's 10th Indian Infantry Brigade at the attack on Gallabat is wrongly given to a sister field ambulance. The practice of placing distinguishing epithets such as "Indian" or "Australian" before the number in the designation of a unit or formation is a source of minor irritation. The list of abbreviations at the beginning of the book is not beyond reproach; it falls into the hoary old error of giving "ADC" as the abbreviation for "Army Dental Centre."

Those who dip into this book will find much to interest and amuse them. They may even find something to envy; they may read, for example, that the L.R.D.G. M.O.'s truck contained "a box with a hinged lid and forming a set of pigeon-holes, each containing a Gordon's gin bottle. In these the liquid stocks were kept." It may be, of course, that this sentence inadvertently conveys a wrong impression.

To the serious student, the book will be of lasting value. It is a worthy addition to the history of the Army Medical Services.

R. J. N.

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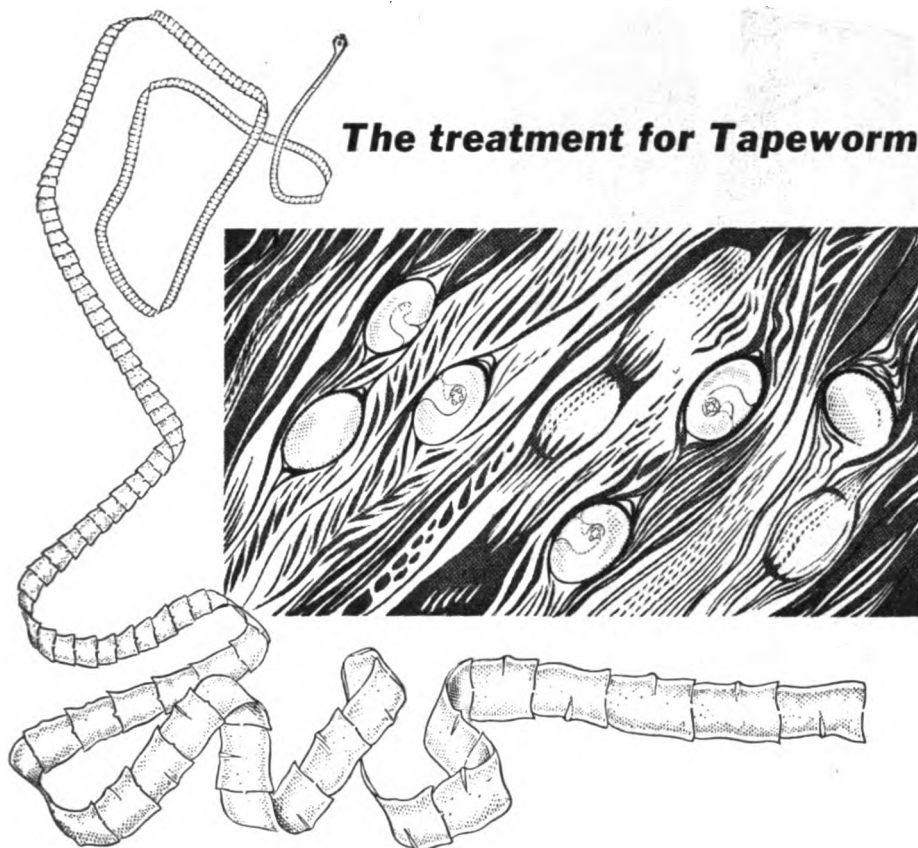
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